





# Ichthyofauna of Sungai Merbok Mangrove Forest Reserve, northwest Peninsular Malaysia, and its adjacent marine waters

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## Abstract

Sungai Merbok Mangrove Forest Reserve, encompassing the Merbok river estuary, was established as a permanent forest reserve in 1951 and is the second-largest intact mangrove forest patch in Peninsular Malaysia. Despite its importance, few studies have been conducted to assess its aquatic biodiversity. In this study, we surveyed the fish diversity of the Merbok river estuary, and its adjacent marine waters. We recorded 138 fish species belonging to two classes, 18 orders, 47 families, and 94 genera. The richest order is Perciformes, with 32 recorded species, represents 23% of the alpha diversity, followed by Carangiformes with 21 recorded species or 14% of the diversity. Low taxonomic diversity overlaps with previous inventories and indicates that the inventory is still incomplete. All specimens examined are catalogued and deposited in a local museum collection. The fish checklist presented here represents a step forward in the conservation of fish diversity in the Merbok river estuary.

## Keywords

Mangrove, Merbok estuary, fish diversity, fish inventory

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## Introduction

Mangrove habitats are among the most vulnerable ecosystems on the planet due to their restricted geographical distribution and their proximity to intense anthropogenic activities (Polidoro et al. 2010). Mangrove habitats perform not only critical ecological functions such as water purification and carbon sequestration but also

deliver important services to local communities in providing raw materials and food as well as coastal protection against flooding (Barbier et al. 2011). Many marine species also use mangrove habitats either to feed, shelter, breed, or nurse their young (reviewed in Whitfield 2017). Such important roles warrant their conservation.



Although mangrove habitats comprise a significant part of the biodiversity, their flora and fauna are still poorly documented in many regions.

One of the largest remaining intact patches of mangrove forests in Malaysia is located within the Merbok river estuary (Kedah State of northwest Peninsular Malaysia) (Fig. 1). The estuary was established as a permanent forest reserve in 1951 and given the name Sungai Merbok Mangrove Forest Reserve. It is the second-largest mangrove forest patch in Peninsular Malaysia after the Larut Matang Forest Reserve in Perak State (Latiff and Faridah-Hanum 2014).

There are only a few studies documenting the aquatic diversity within this region (Mansor et al. 2012a, 2012b; Jamaluddin et al. 2019). At least 81 species of fish inhabiting the Merbok river estuary (representing 36 families) were listed by Mansor et al. (2012b). This number is obviously low when compared to the fish diversity in Sikao Creek estuary, Thailand, which is about 100 km north of the Merbok river estuary; in the Sikao Creek estuary, 135 fish species and 43 families were documented (Tongnunui et al. 2002). We present here a checklist of the fishes of Merbok river estuary and adjacent marine waters based on our recent sampling done in 2018 and 2019. To facilitate further comparative investigations, we established a dedicated section to house the tissue and specimen collection at the Makmal Rujukan Zoologi (Zoological Reference Laboratory) of Universiti Sains Malaysia.

Study Area

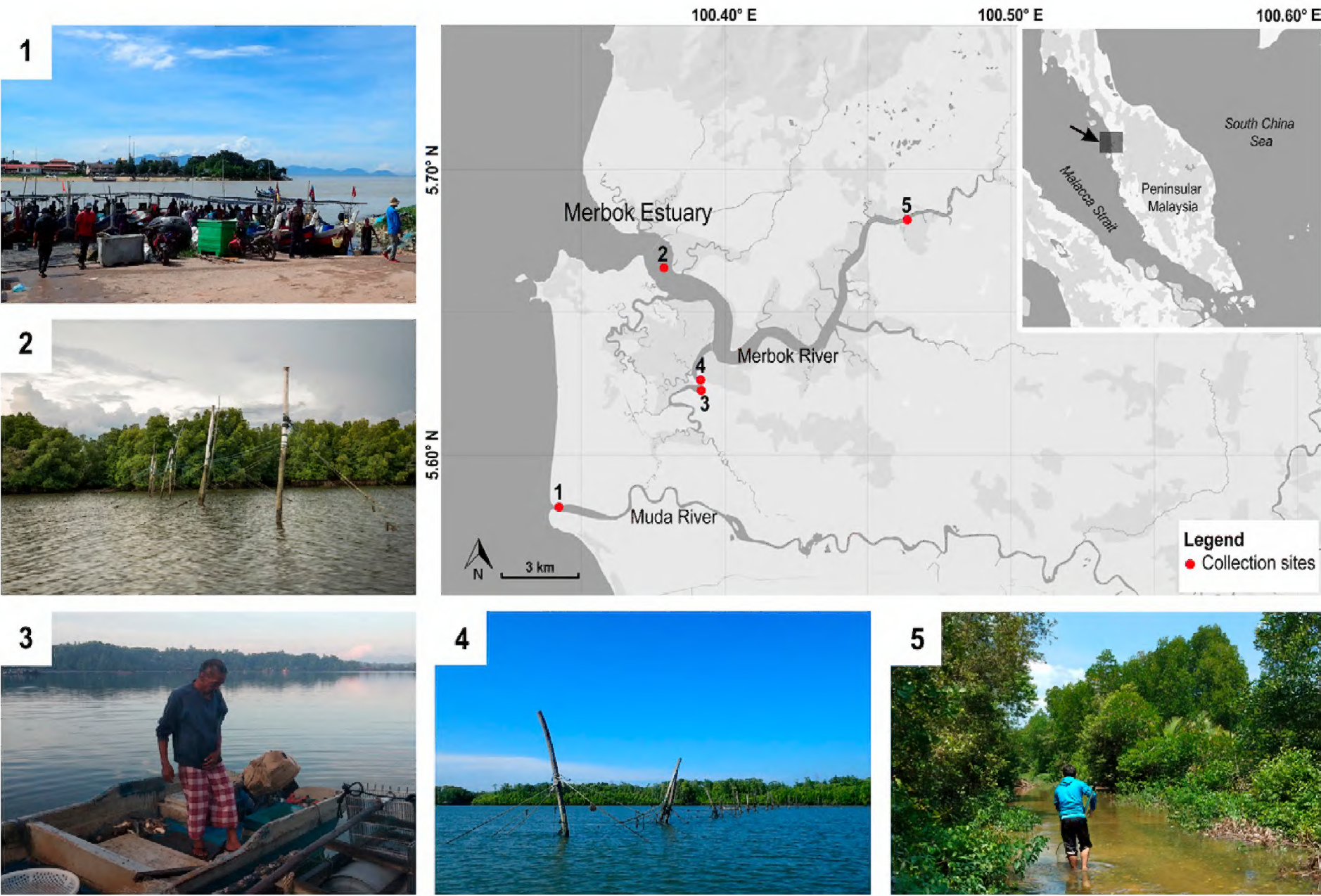
Our study was carried out at five locations within and near to the Merbok river estuary, Kedah, Malaysia (Fig. 1). The Merbok River has a length of approximately 45 km and a catchment area of about 550 km<sup>2</sup>, and its relatively large estuary comprises about 40 km<sup>2</sup> of mangrove forest (Fatema et al. 2014). The estuary is connected to the lower part of the Muda River in the south through a natural channel. Geographical coordinates of the sampling localities are presented in Table 1.

Methods

We sampled and examined 441 fish specimens over a period of 11 months (December 2018–October 2019) on six sampling trips. Each of these trips covering more than one locality. Specimens were collected either from

**Table 1.** Geographical coordinates of the sampling localities in the Merbok river estuary and its adjacent waters.

Site	Locality	Geographic coordinates	
		N	E
1	Kuala Muda Whispering Market	05.578°	100.341°
2	Pompang Sungai Merbok	05.664°	100.381°
3	Pompang Batu Lintang (A)	05.624°	100.395°
4	Pompang Batu Lintang (B)	05.625°	100.394°
5	Semeling Bridge	05.680°	100.470°



**Figure 1.** Map of Merbok river estuary, Kedah, Peninsular Malaysia, showing the positions of sampling localities. Sampling sites: 1 = Kuala Muda Whispering Market, 2 = Pompang Sungai Merbok, 3 and 4 = Pompang Batu Lintang, 5 = Semeling Bridge. Inset map shows the location of the study area within Peninsular Malaysia.



local fishermen who obtained their catches using traditional barrier-nets (locally called “pompong”; 10–30 m in length and 2 cm between knots) in the estuary (sites 2 and 4), by dip-net (1–5 mm net mesh size), seine net (1.2 × 7.6 m and 1 cm between knots) (sites 3 and 5), or bought from a fish-landing site at Kuala Muda Whispering Market (site 1) at the mouth of the Muda River. At this site, catches are landed by purse seiners and trawlers, which operate up to 5 nautical miles (Zone “A”) or from 5 to 12 nautical miles (Zone “B”) offshore (Nuruddin and Isa 2013) near the Merbok river estuary.

We took photographs of all fresh specimens collected. Then, a fin clipping from each specimen was stored in 90% ethanol for future molecular work. Most specimens were fixed in 10% formalin for at least one week before being washed and transferred in 70% ethanol for long-term storage. A few small specimens were directly preserved in 70% ethanol. Specimen vouchers were given museum catalogue numbers and deposited at the Museum of Biodiversity, Universiti Sains Malaysia, Penang. The total length (TL) of each specimen was measured except for rays, for which we measured their disk width (DW).

All specimens were initially identified using the morphology-based identification keys of Carpenter and Niem (1999a, 1999b, 2001a, 2001b). We then consulted the most recent taxonomic revisions (where available) for each family to improve our initial identifications. In particular, we referred to the taxonomic works of Last et al. (2016) for the family Dasyatidae, Hata et al. (2021) for

the engraulid genus *Stolephorus*, Marceniuk and Menezes (2007) for the family Ariidae, Huang et al. (2013) for the family Gobiidae, Durand et al. (2012) for the family Mugilidae, Sparks and Chakrabarty (2015) for the family Leiognathidae, Motomura (2004) for the family Polynemidae, and Morishita et al. (2020) for the family Sphyraenidae. Species names were checked with the online version of the *Eschmeyer’s Catalog of Fishes* (Fricke et al. 2020). The ordinal and familial classification follows Van der Laan et al. (2020). The list of species recorded in this study along with information on their associated specimens (such as museum catalogue numbers) are presented in Table 2.

Results

We recorded a total of 138 species of fish in Merbok river estuary and adjacent waters, belonging to two classes (Chondrichthyes and Actinopterygii), 18 orders, 47 families, and 94 genera (Table 2). Photographs of representatives of most families are shown in Figures 2–5. The class Chondrichthyes is represented by the order Myliobatiformes (three species) and the order Orectolobiformes (one species). The remaining 134 species are ray-finned fishes classified into 16 orders, 44 families, and 90 genera. The four families with the highest species richness are Gobiidae (with 14 species, representing about 10% of the total number of species), Carangidae (12 species, 8.6%), Ariidae (eight species, 5.8%), and Engraulidae (nine species, 6.5%).

**Table 2.** Fish species collected in the Merbok river estuary and adjacent waters. M1 = samples derived from localities across Merbok river estuary (Sites 2–5); M2 = samples derived from fish landing site (Site 1); L1 and L2 = species that overlap with the lists of Mansor et al. (2012a) and Tongnunui et al. (2002), respectively. Ordinal and familial classification follows Van der Laan et al. (2020).

Species (classified by order and family)	Museum catalogue no.	M1	M2	L1	L2	Remarks
<b>MYLIOBATIFORMES</b>						
<b>Dasyatidae Jordan &amp; Gilbert, 1879</b>						
<i>Brevitrygon walga</i> (Müller & Henle, 1841)	USMFC (1) 00003		X	X		Listed as <i>Himantura walga</i> by Mansor et al. (2012a)
<i>Telatrygon zugei</i> (Bürger, 1841)	USMFC (1) 00002		X			
<b>Gymnuridae Fowler, 1934</b>						
<i>Gymnura poecilura</i> (Shaw, 1804)	USMFC (104) 00001, USMFC (104) 00002		X	X		
<b>ORECTOLOBIFORMES</b>						
<b>Hemiscylliidae Gill, 1862</b>						
<i>Chiloscyllium indicum</i> (Gmelin, 1789)	USMFC (114) 00001	X				
<b>ANGUILLIFORMES</b>						
<b>Ophichthidae Günther, 1870</b>						
<i>Pisodonophis cancrivorus</i> (Richardson, 1848)	USMFC (106) 00001	X				
<b>CLUPEIFORMES</b>						
<b>Chirocentridae Bleeker, 1849</b>						
<i>Chirocentrus nudus</i> Swainson, 1839	USMFC (72) 00001		X			
<b>Clupeidae Cuvier, 1816</b>						
<i>Anodontostoma chacunda</i> (Hamilton, 1822)	USMFC (5) 00005, USMFC (5) 00006, USMFC (5) 00008	X	X	X	X	
<i>Escualosa thoracata</i> (Valenciennes, 1847)	USMFC (5) 00003		X		X	
<i>Sardinella albella</i> (Valenciennes, 1847)	USMFC (5) 00007, USMFC (5) 00009	X				
<i>Sardinella gibbosa</i> (Bleeker, 1849)	USMFC (5) 00004		X			
<b>Dussumieriidae Gill, 1861</b>						
<i>Dussumieria albulina</i> (Fowler, 1934)	USMFC (103) 00001	X				
<b>Engraulidae Gill, 1861</b>						
<i>Setipinna taty</i> (Valenciennes, 1848)	USMFC (82) 00047	X				







Species (classified by order and family)	Museum catalogue no.	M1	M2	L1	L2	Remarks
<i>Hyporhamphus dussumieri</i> (Valenciennes, 1847)	USMFC (105) 00002		X			
<i>Hyporhamphus quoyi</i> (Valenciennes, 1847)	USMFC (105) 00001, USMFC (105) 00005	X	X	X		
Zenarchopteridae Fowler, 1934						
<i>Dermogenys sumatrana</i> (Bleeker, 1854)	USMFC (105) 00004	X				
<i>Zenarchopterus buffonis</i> (Valenciennes, 1847)	USMFC (105) 00003	X			X	
CARANGIFORMES						
Carangidae Rafinesque, 1815						
<i>Alepes melanoptera</i> (Swainson, 1839)	USMFC (69) 00013, USMFC (69) 00014	X	X			
<i>Atule mate</i> (Cuvier, 1833)	USMFC (69) 00015	X				
<i>Carangoides coeruleopinnatus</i> (Rüppell, 1830)	USMFC (69) 00012		X			
<i>Caranx ignobilis</i> (Forsskål, 1775)	USMFC (69) 00019, USMFC (69) 00020		X		X	
<i>Caranx sexfasciatus</i> Quoy & Gaimard, 1825	USMFC (69) 00022		X	X	X	
<i>Megalaspis cordyla</i> (Linnaeus, 1758)	USMFC (69) 00009		X			
<i>Scomberoides commersonnianus</i> Lacepède, 1801	USMFC (69) 00016	X				
<i>Scomberoides tala</i> (Cuvier, 1832)	USMFC (69) 00018	X				
<i>Scomberoides tol</i> (Cuvier, 1832)	USMFC (69) 00017	X				
<i>Selaroides leptolepis</i> (Cuvier, 1833)	USMFC (69) 00010		X			
<i>Trachinotus blochii</i> (Lacepède, 1801)	USMFC (69) 00021		X			
<i>Ulua mentalis</i> (Cuvier, 1833)	USMFC (69) 00011		X			
Cynoglossidae Jordan, 1888						
<i>Cynoglossus arel</i> (Bloch & Schneider, 1801)	USMFC (84) 00007		X			
<i>Cynoglossus puncticeps</i> (Richardson, 1846)	USMFC (84) 00003, USMFC (84) 00006	X				
<i>Cynoglossus cynoglossus</i> (Hamilton, 1822)	USMFC (84) 00002, USMFC (84) 00005	X	X			
<i>Cynoglossus lingua</i> Hamilton, 1822	USMFC (84) 00008		X	X		
<i>Cynoglossus oligolepis</i> (Bleeker, 1855)	USMFC (84) 00004	X				
Paralichthyidae Regan, 1910						
<i>Pseudorhombus elevatus</i> Ogilby, 1912	USMFC (107) 00001		X			
Latidae Jordan, 1888						
<i>Lates calcarifer</i> (Bloch, 1790)	USMFC (76) 00001		X	X	X	
Polynemidae Rafinesque, 1815						
<i>Eleutheronema tetradactylum</i> (Shaw, 1804)	USMFC (68) 00005, USMFC (68) 00006		X	X		
<i>Leptomelanosoma indicum</i> (Shaw, 1804)	USMFC (68) 00004	X				
MUGILIFORMES						
Mugilidae Jarocki, 1822						
<i>Crenimugil buchanani</i> (Bleeker, 1853)	USMFC (81) 00006		X			
<i>Crenimugil crenilabis</i> (Forsskål, 1775)	USMFC (81) 00007		X			
<i>Osteomugil perusii</i> (Valenciennes, 1836)	USMFC (81) 00003, USMFC (81) 00004		X			
<i>Planiliza subviridis</i> (Valenciennes, 1836)	USMFC (81) 00001, USMFC (81) 00002, USMFC (81) 00005, USMFC (81) 00008	X	X			
PERCIFORMES						
Gerreidae Bleeker, 1859						
<i>Gerres macracanthus</i> Bleeker, 1854	USMFC (91) 00008		X			
<i>Gerres filamentosus</i> Cuvier, 1829	USMFC (91) 00005, USMFC (91) 00006, USMFC (91) 00007	X	X	X	X	
<i>Gerres limbatus</i> Cuvier, 1830	USMFC (91) 00004	X			X	
<i>Gerres oyena</i> (Forsskål, 1775)	USMFC (91) 00003		X	X		
Ambassidae Klunzinger, 1870						
<i>Ambassis vachellii</i> Richardson, 1846	USMFC (30) 00002, USMFC (30) 00003	X	X			
<i>Ambassis interrupta</i> Bleeker, 1853	USMFC (30) 00006	X			X	
<i>Ambassis macracanthus</i> Bleeker, 1849	USMFC (30) 00004, USMFC (30) 00005, USMFC (30) 00007	X			X	
Haemulidae Gill, 1885						
<i>Pomadasys kaakan</i> (Cuvier, 1830)	USMFC (71) 00002, USMFC (71) 00003, USMFC (71) 00004, USMFC (71) 00005	X	X	X	X	
Lethrinidae Bonaparte, 1831						
<i>Lethrinus lentjan</i> (Lacepède, 1802)	USMFC (79) 00001		X	X		
Lutjanidae Gill, 1861						
<i>Lutjanus argentimaculatus</i> (Forsskål, 1775)	USMFC (49) 00012		X	X		
<i>Lutjanus johnii</i> (Bloch, 1792)	USMFC (49) 00007, USMFC (49) 00011		X	X	X	
<i>Lutjanus russellii</i> (Bleeker, 1849)	USMFC (49) 00006, USMFC (49) 00008, USMFC (49) 00009, USMFC (49) 00010		X	X	X	
Sciaenidae Cuvier, 1829						
<i>Dendrophysa russellii</i> (Cuvier, 1829)	USMFC (48) 00009		X	X	X	
<i>Johnius belangerii</i> (Cuvier, 1830)	USMFC (48) 00010, USMFC (48) 00011, USMFC (48) 00012	X	X			
<i>Johnius</i> sp.	USMFC (48) 00002, USMFC (48) 00008		X			



Species (classified by order and family)	Museum catalogue no.	M1	M2	L1	L2	Remarks
<i>Otolithes ruber</i> (Bloch & Schneider, 1801)	USMFC (48) 00004		X			
<i>Panna microdon</i> (Bleeker, 1849)	USMFC (48) 00007		X			
<i>Pennahia anea</i> (Bloch, 1793)	USMFC (48) 00006		X		X	
<i>Pennahia ovata</i> Sasaki, 1996	USMFC (48) 00003		X			
<b>Serranidae Swainson, 1839</b>						
<i>Cephalopholis formosa</i> (Shaw, 1812)	USMFC (74) 00008	X				
<i>Epinephelus bleekeri</i> (Vaillant, 1878)	USMFC (74) 00009	X				
<i>Epinephelus coioides</i> (Hamilton, 1822)	USMFC (74) 00006		X	X	X	
<i>Epinephelus heniochus</i> Fowler, 1904	USMFC (74) 00005		X			
<i>Epinephelus sexfasciatus</i> (Valenciennes, 1828)	USMFC (74) 00007		X			
<b>Sillaginidae Richardson, 1846</b>						
<i>Sillago sihama</i> (Forsskål, 1775)	USMFC (53) 00002, USMFC (53) 00003	X	X	X	X	
<b>Sphyraenidae Rafinesque, 1815</b>						
<i>Sphyraena barracuda</i> (Edwards, 1771)	USMFC (62) 00006	X		X	X	
<i>Sphyraena jello</i> Cuvier, 1829	USMFC (62) 00004, USMFC (62) 00007	X				
<i>Sphyraena qenie</i> Klunzinger, 1870	USMFC (62) 00005		X			
<b>Platycephalidae Swainson, 1839</b>						
<i>Grammolites scaber</i> (Linnaeus, 1758)	USMFC (56) 00006		X			
<i>Platycephalus indicus</i> (Linnaeus, 1758)	USMFC (56) 00007	X				
<b>Tetrarogidae Smith, 1949</b>						
<i>Trichosomus trachinoides</i> (Cuvier, 1829)	USMFC (115) 00001, USMFC (115) 00002	X				
<b>CICHLIFORMES</b>						
<b>Cichlidae Bonaparte, 1835</b>						
<i>Oreochromis mossambicus</i> (Peters, 1852)	USMFC (47) 00005	X		X		
<b>ACANTHURIFORMES</b>						
<b>Drepaneidae Gill, 1872</b>						
<i>Drepane longimana</i> (Bloch & Schneider, 1801)	USMFC (60) 00002	X				
<i>Drepane punctata</i> (Linnaeus, 1758)	USMFC (60) 00003		X			
<b>Leiognathidae Gill, 1893</b>						
<i>Deveximentum ruconius</i> (Hamilton, 1822)	USMFC (50) 00013		X			
<i>Deveximentum indicium</i> (Monkolprasit, 1973)	USMFC (50) 00012, USMFC (50) 00015		X			
<i>Deveximentum hanedai</i> (Mochizuki & Hayashi, 1989)	USMFC (50) 00014		X			
<i>Eubleekeria jonesi</i> (James, 1971)	USMFC (50) 00016	X				
<i>Leiognathus brevirostris</i> (Valenciennes, 1835)	USMFC (50) 00011		X			
<i>Leiognathus equula</i> (Forsskål, 1775)	USMFC (50) 00017	X			X	
<i>Nuchequula gerreoides</i> (Bleeker, 1851)	USMFC (50) 00010, USMFC (50) 00018	X	X			
<b>Scatophagidae Gill, 1883</b>						
<i>Scatophagus argus</i> (Linnaeus, 1766)	USMFC (109) 00001		X	X	X	
<b>Siganidae Richardson, 1837</b>						
<i>Siganus fuscescens</i> (Houttuyn, 1782)	USMFC (67) 00001	X				
<i>Siganus javus</i> (Linnaeus, 1766)	USMFC (67) 00002	X		X	X	
<b>SCOMBRIFORMES</b>						
<b>Stromateidae Rafinesque, 1810</b>						
<i>Pampus argenteus</i> (Euphrasen, 1788)	USMFC (110) 00001, USMFC (110) 00002	X	X	X		
<b>Trichiuridae Rafinesque, 1810</b>						
<i>Lepturacanthus savala</i> (Cuvier, 1829)	USMFC (73) 00001		X			
<b>CENTRARCHIFORMES</b>						
<b>Terapontidae Richardson, 1842</b>						
<i>Terapon jarbua</i> (Forsskål, 1775)	USMFC (88) 00004, USMFC (88) 00006	X		X		
<i>Terapon theraps</i> Cuvier, 1829	USMFC (88) 00003, USMFC (88) 00005		X		X	
<b>TETRAODONTIFORMES</b>						
<b>Tetraodontidae Bonaparte, 1831</b>						
<i>Arothron reticularis</i> (Bloch & Schneider, 1801)	USMFC (40) 000010	X			X	
<i>Dichomyctere</i> cf. <i>fluviatilis</i> (Hamilton, 1822)	USMFC (40) 00006	X		X		Listed as <i>Tetraodon fluviatilis</i> by Mansor et al. (2012a)
<i>Dichomyctere nigroviridis</i> (Marion de Procé, 1822)	USMFC (40) 00011	X		X		Listed as <i>Tetraodon nigroviridis</i> by Mansor et al. (2012a)
<i>Lagocephalus lunaris</i> (Bloch & Schneider, 1801)	USMFC (40) 00005, USMFC (40) 00004, USMFC (40) 00007, USMFC (40) 00008	X	X			
<i>Takifugu oblongus</i> (Bloch, 1786)	USMFC (40) 00009		X			
<b>Triacanthidae Bleeker, 1859</b>						
<i>Triacanthus nieuhofii</i> Bleeker, 1852	USMFC (61) 00002, USMFC (61) 00003	X	X			



Out of these 138 species, 76 species are collected in the Merbok river estuary and 82 species from the adjacent marine areas whereby 57 species were exclusively sampled within the Merbok river estuary (from four sampling sites) and 63 species were exclusively collected at the fish landing site at Kuala Muda Whispering Market. Only 19 species (about 13.8%) were found both in the Merbok river estuary and at the fish landing site (Table 2).

Five species we collected at site 1 (fish landing market) are classified as Near Threatened in the International Union for Conservation of Nature's Red List of Threatened Species (IUCN 2020). They are Pale-edged Stingray, *Telatrygon zugei* (Bürger, 1841); Scaly Whipray, *Brevitrygon walga* (Müller & Henle, 1841); Long-tailed Butterfly, *Gymnura poecilura* (Shaw, 1804); Slender Bamboo Shark, *Chiloscyllium indicum* (Gmelin, 1789); and Gagora Catfish, *Arius gagora* (Hamilton, 1822). All other species are classified as Least concern, Data Deficient, and Not Evaluated. We recorded the presence of Mozambique Tilapia, *Oreochromis mossambicus* (Peters, 1852), an alien, invasive fish species, predominantly living in freshwater but also tolerating higher salinity, which was introduced for aquaculture purposes in Malaysian waters (Rahim et al. 2013). Three more species collected, *Lates calcarifer* (Bloch, 1790), *Lutjanus russelli* (Bleeker, 1849) and *Epinephelus coioides* (Hamilton, 1822), are cage-farmed in the estuary (from imported seed stock), but they are also naturally found in this region (Carpenter and Niem 2001a), making it difficult to determine the origin of the captured specimens.

Order Myliobatiformes

Family Dasyatidae

#### ***Brevitrygon walga* (Müller & Henle, 1841)**

Figure 2A

**Material examined.** MALAYSIA • 1 ♂, 160 mm disc width (DW), tail missing; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (1) 00003.

**Identification.** A small species of dasyatid (maximal disc width less than 180 mm); snout elongate, forming a projecting tip; anterior disc margins slightly concave; eye small; large band of compact denticles running along centre of the disc to the tail sting; dorsal surface of the disc light grey-brown, paler on margins, ventral side of the disc white (Carpenter and Niem 1999a).

*Brevitrygon walga* can be distinguished from all other stingrays occurring in this region by its large band of compact denticles running along centre of disc. A common coastal species in Southeast Asia regularly occurring in brackish environments. Generic classification follows Last et al. (2016); this species was previously classified in the genus *Himantura* (e.g., Weigmann 2011).

#### ***Telatrygon zugei* (Bürger, 1841)**

Figure 2B

**Material examined.** MALAYSIA • 1 ♀, 148 mm DW, tail missing; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (1) 00002.

**Identification.** A small species of dasyatid (maximal disc width less than 300 mm); elongated snout with largely concave disc anterior margins; eye small; no dark transverse band through the eyes; dorsal surface of the disc uniformly brown, ventral side of the disc uniformly pale greyish (Carpenter and Niem 1999a).

According to Weigmann (2011), *T. zugei* can be distinguished from all other stingrays occurring in this region by its very elongated snout with the broadly concave anterior margins of the disc. A common coastal species in Southeast Asia regularly occurring in brackish environments. Generic classification follows Last et al. (2016); previously classified in the genus *Dasyatis*.

Family Gymnuridae

#### ***Gymnura poecilura* (Shaw, 1804)**

Figure 2C

**Material examined.** MALAYSIA • 1 ♂, 475 mm DW; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (104) 00001. • 1 ♂, 285 mm DW; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (104) 00002.

Order Orectolobiformes

Family Hemiscylliidae

#### ***Chiloscyllium indicum* (Gmelin, 1789)**

Figure 2D

**Material examined.** MALAYSIA • 1, 170 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 10 Oct. 2019; Sébastien Lavoué leg.; USMFC (114) 00001.

Order Anguilliformes

Family Ophichthidae

#### ***Pisodonophis cancrivorus* (Richardson, 1848)**

Figure 2E

**Material examined.** MALAYSIA • 1, 254 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (106) 00001.

Order Clupeiformes

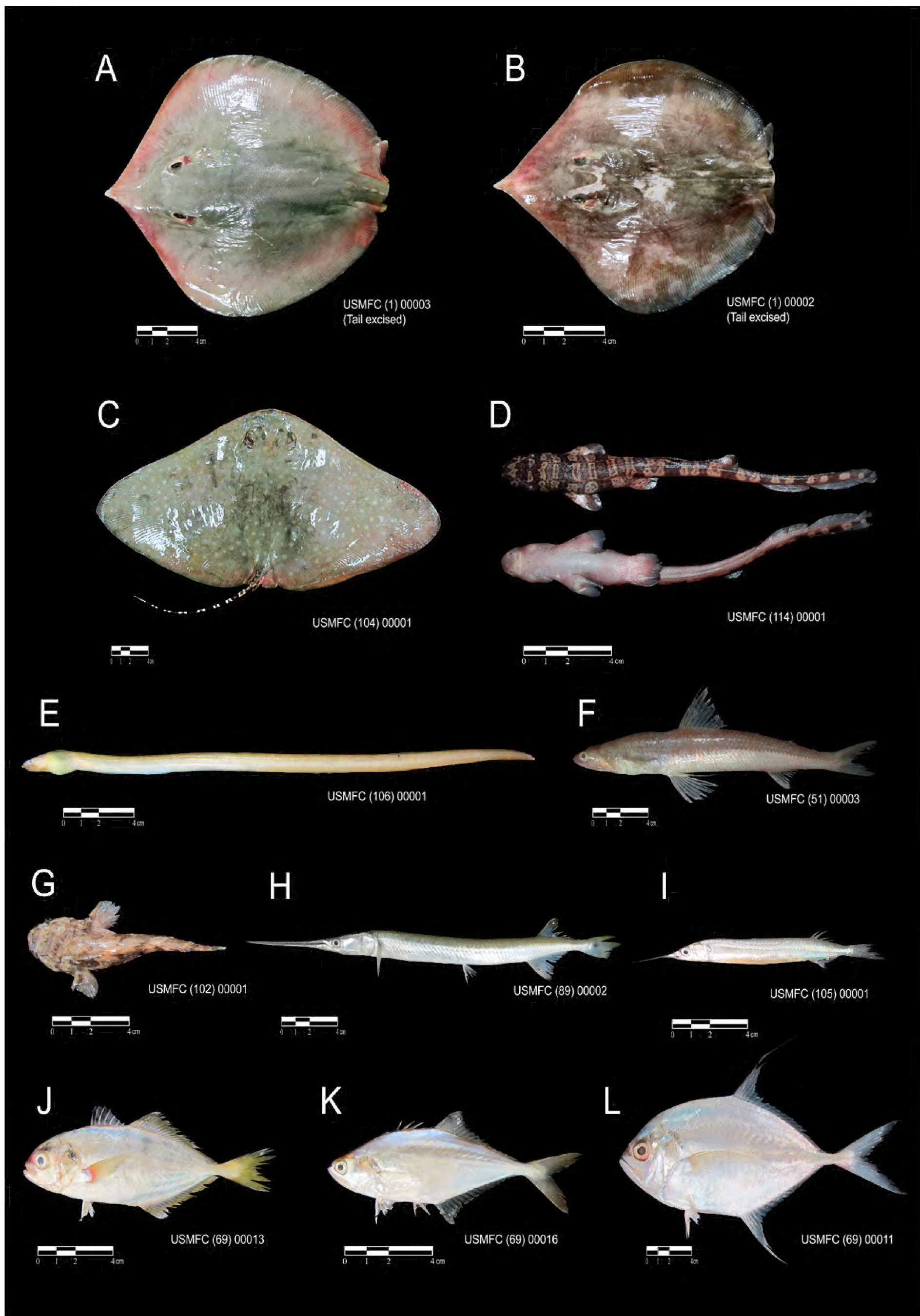
Family Chirocentridae

#### ***Chirocentrus nudus* Swainson, 1839**

Figure 3A

**Material examined.** MALAYSIA • 2, 339–340 mm





**Figure 2.** Photographs of a selection of fish specimens (in dorsal, ventral, or lateral views) from the Merbok river estuary and adjacent waters. **A.** *Brevitrygon walga*. **B.** *Telatrygon zugei*. **C.** *Gymnura poecilura*. **D.** *Chiloscyllium indicum*. **E.** *Pisodonophis cancrivorus*. **F.** *Saurida micropectoralis*. **G.** *Batrachomoeus trispinosus*. **H.** *Strongylura strongylura*. **I.** *Hyporhamphus quoyi*. **J.** *Ulua mentalis*. **K.** *Scomberoides commersonianus*. **L.** *Alepes melanoptera*.



TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (72) 00001.

**Identification.** A large species of herring-like fish (maximum TL reported about 1000 mm); body very elongated and strongly compressed; no scutes along the belly; mouth large with two exposed fang-like canine teeth pointing forward in the upper jaw; large teeth in lower jaw; no lateral line; dorsal and anal fins beginning at about the same level, well behind midpoint of body; anal fin longer than dorsal fin, caudal fin forked; back dark blue, flanks and belly silver; fins mostly translucent (Whitehead 1985).

Wolf herrings (genus *Chirocentrus*) are straightforwardly recognisable. Only two species are valid and occur in this region: *C. nudus* resembles *Chirocentrus dorab* (Forsskal, 1775) but can be distinguished by the absence of black marking on dorsal fin. *Chirocentrus nudus* is a predominantly coastal marine species; young individuals occasionally occur in brackish ecosystems. Widely distributed in the Indo-West Pacific region (Whitehead 1985).

Family Clupeidae

#### *Anodontostoma chacunda* (Hamilton, 1822)

Figure 3B

**Material examined.** MALAYSIA • 3, 121–125 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (5) 00005. • 1, 100 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (5) 00006. • 5, 61–111 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (5) 00008.

**Identification.** A small species of Clupeidae (maximum TL about 100 mm); body deep, laterally compressed and strongly keeled from isthmus to anus; mouth small inferior; last dorsal fin ray not filamentous; lower gill rakers 54–96 (on first gill arch; data from Whitehead 1985); longest gill rakers on lower part of arch less than corresponding gill filaments; posterior edges of scales indented, the indentations smaller than gaps between them; body silver, back darker; a large, dark, ovoid mark behind upper part of gill opening, covering about four scales. Fins mostly translucent (Whitehead 1985).

*Anodontostoma chacunda* can be distinguished from other clupeids collected by its deep body, high number of lower gill rakers and a conspicuous large dark ovoid mark behind upper part of gill opening. *Anodontostoma chacunda* is a predominantly coastal marine species and one of the most common species of Clupeidae occurring in brackish ecosystems of this region (e.g., Tongnunui et al. 2002; this study). Otherwise, distributed in

the Indo-West Pacific region, from the Persian Gulf to Australia (Whitehead 1985).

#### *Escualosa thoracata* (Valenciennes, 1847)

Figure 3C

**Material examined.** MALAYSIA • 5, 91–101 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (5) 00003.

**Identification.** A small species of Clupeidae (maximum TL about 100 mm); body relatively deep, strongly compressed and fully keeled from isthmus to anus (scutes 28–30); mouth small, upward; last dorsal fin ray not filamentous; lower gill rakers 16–25 (on first gill arch); body light greyish/greenish with a large (i.e., 1½ larger than eye diameter) silver lateral stripe on flanks, from the opercular margin to caudal fin base; paired lines of melanophores along back, from occiput to caudal fin base; fins mostly translucent; caudal fin with black margin (Whitehead 1985).

*Escualosa thoracata* can be distinguished from other clupeids occurring in the Merbok river estuary by the presence of large silver lateral stripe on flanks. *Escualosa thoracata* is a predominantly coastal marine species and a common species of Clupeidae caught in brackish ecosystems of this region (e.g., Tongnunui et al. 2002). Otherwise, distributed in the Indo-West Pacific region, from India to Australia (Whitehead 1985).

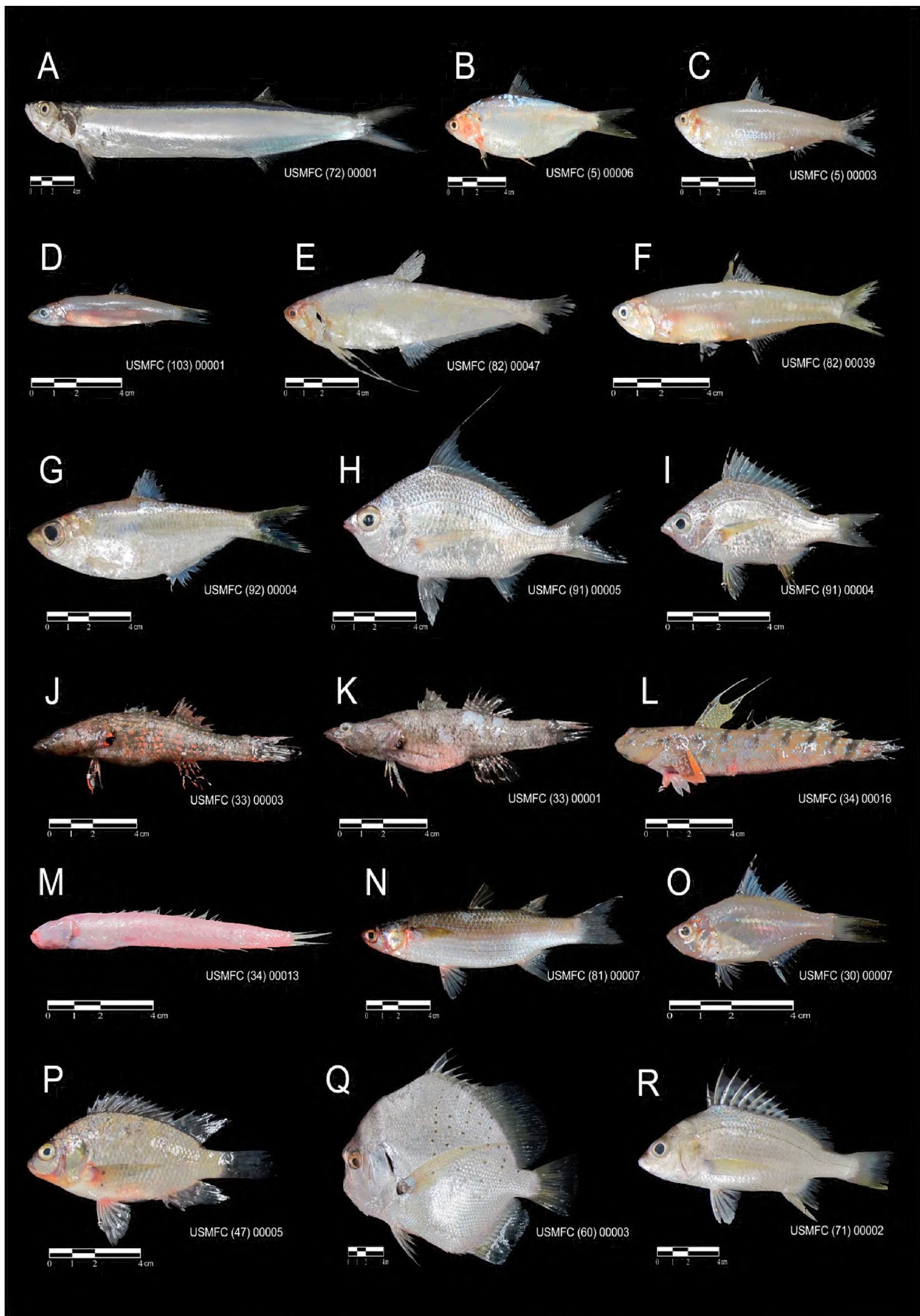
#### *Sardinella albella* (Valenciennes, 1847)

**Material examined.** MALAYSIA • 1, 57 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (5) 00007. • 1, 75 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (5) 00009.

**Identification.** Recently rediagnosed by Stern et al. (2016). A moderate-sized species of Clupeidae (maximum TL about 150 mm); body relatively deep, strongly compressed and fully keeled from isthmus to anus (scutes 30 or 31); mouth small, upward; no lateral line; last dorsal fin ray not filamentous; lower gill rakers 47–64 (on first gill arch); vertical striae on scales discontinuous, not meeting at centre; flanks and belly silver, dorsum dark grey-blue; a black mark at the dorsal fin base, a diffuse ovoid black mark behind upper part of gill opening.

*Sardinella albella* is similar to *Sardinella gibbosa* (Bleeker, 1849) occurring in the Merbok river estuary but it can be distinguished by its deeper body and lower number of scutes (31 or less vs. 32 in *S. gibbosa*). *Sardinella albella* is a predominantly coastal marine species and a common species of Clupeidae caught in brackish ecosystems of this region (Tongnunui et al. 2002). Otherwise, widely distributed in the Indo-West Pacific region (Whitehead 1985).





**Figure 3.** Photographs of a selection of fish specimens (in dorsal or lateral views) from the Merbok river estuary and adjacent waters. **A.** *Chirocentrus nudus*. **B.** *Anodontostoma chacunda*. **C.** *Escualosa thoracata*. **D.** *Dussumieria albulina*. **E.** *Setipinna taty*. **F.** *Stolephorus tri.* **G.** *Ilisha melastoma*. **H.** *Gerres filamentosus*. **I.** *Gerres limbatus*. **J.** *Butis butis*. **K.** *Butis humeralis*. **L.** *Boleophthalmus boddarti*. **M.** *Trypauchen vagina*. **N.** *Crenimugil crenilabis*. **O.** *Ambassis macracanthus*. **P.** *Oreochromis mossambicus*. **Q.** *Drepane punctata*. **R.** *Pomadasys kaakan*.



***Sardinella gibbosa* (Bleeker, 1849)**

**Material examined.** MALAYSIA • 2, 121–131 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (5) 00004.

**Identification.** Recently rediagnosed in Stern et al. (2016). A moderate-sized species of Clupeidae (maximum TL about 170 mm); body relatively slender, strongly compressed and fully keeled from isthmus to anus (scutes 32); mouth small, upward; no lateral line; last dorsal fin ray not filamentous; lower gill rakers on first gill arch 48–69; vertical striae on scales discontinuous, not meeting at centre; flanks and belly silver, dorsum dark grey-blue; a black mark at the dorsal fin base, a diffuse ovoid black mark behind upper part of gill opening.

*Sardinella gibbosa* can be separated from *S. albella* occurring in the Merbok river estuary by a relatively slender body and more scutes. *Sardinella gibbosa* is a predominantly coastal marine species and one of the most common species of Clupeidae caught in brackish ecosystems of this region (Tongnunui et al. 2002). Otherwise, widely distributed in the Indo-West Pacific region, from India to Australia (Whitehead 1985).

Family Dussumieriidae

***Dussumieria albulina* (Fowler, 1934)**

Figure 3D

**Material examined.** MALAYSIA • 3, 62–65 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (103) 00001.

**Identification.** Species recently rediagnosed and revalidated in Hata et al. (2021); maximum TL about 150 mm; body elongated and rounded; belly not keeled without pre- and post-pelvic scutes; W-shaped pelvic scute; no predorsal scute; branchiostegal rays 12–17; rectangular premaxillae; mouth terminal; anal fin short with three unbranched and 11–14 branched fin rays; gill rakers on first gill arch 33–41; no teeth on parasphenoid; dorsal part of the body deep blue, lateral and ventral parts uniformly silver; deep blue and silver parts separated by yellow-greenish longitudinal stripes on each side (Hata et al. 2021); fins mostly translucent with melanophores scattered on 3<sup>rd</sup> to 9<sup>th</sup> pectoral-fin rays (numerated from the uppermost ray).

*Dussumieria albulina* closely resembles *Dussumieria acuta* Valenciennes, 1847, but it can be distinguished by the absence of teeth on parasphenoid and the presence of black marking on 3<sup>rd</sup> to 9<sup>th</sup> pectoral-fin rays (Hata et al. 2021). Previous records of *D. acuta* in this region may refer to *D. albulina* (although the two species may also occur sympatrically). *Dussumieria albulina* is a predominantly coastal marine species commonly recorded in brackish ecosystems of this region; we collected three juveniles from the Merbok river estuary. Otherwise,

distributed in the Indo-West Pacific region, from India to the Philippines (Hata et al. 2021).

Family Engraulidae

***Setipinna taty* (Valenciennes, 1848)**

Figure 3E

**Material examined.** MALAYSIA • 1, 141 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00047.

**Identification.** A moderate sized species of anchovy (maximum SL <200 mm); body strongly laterally compressed; longer than deeper; very large mouth, its corner well behind the eye; anal fin rays 18 or 19; belly strongly keeled with 22–27 prepelvic scutes and 11 or 12 post-pelvic scutes; gill rakers 18–20 only (on first gill arch); scales present on dorsal and anal fins; pectoral fin with a long filament reaching the posterior half of the anal fin; body uniformly silver sometimes orangish; no silver longitudinal stripe; no dark pigment line on back (Whitehead et al. 1988).

The presence of a long pectoral filament makes it easy to separate *S. taty* from other species of anchovy recorded from the Merbok estuary. *Setipinna taty* is a predominantly coastal marine species although commonly frequenting brackish ecosystems of this region; it does not seem to form large school. Otherwise, widely distributed in the Indo-West Pacific region (Whitehead et al. 1988).

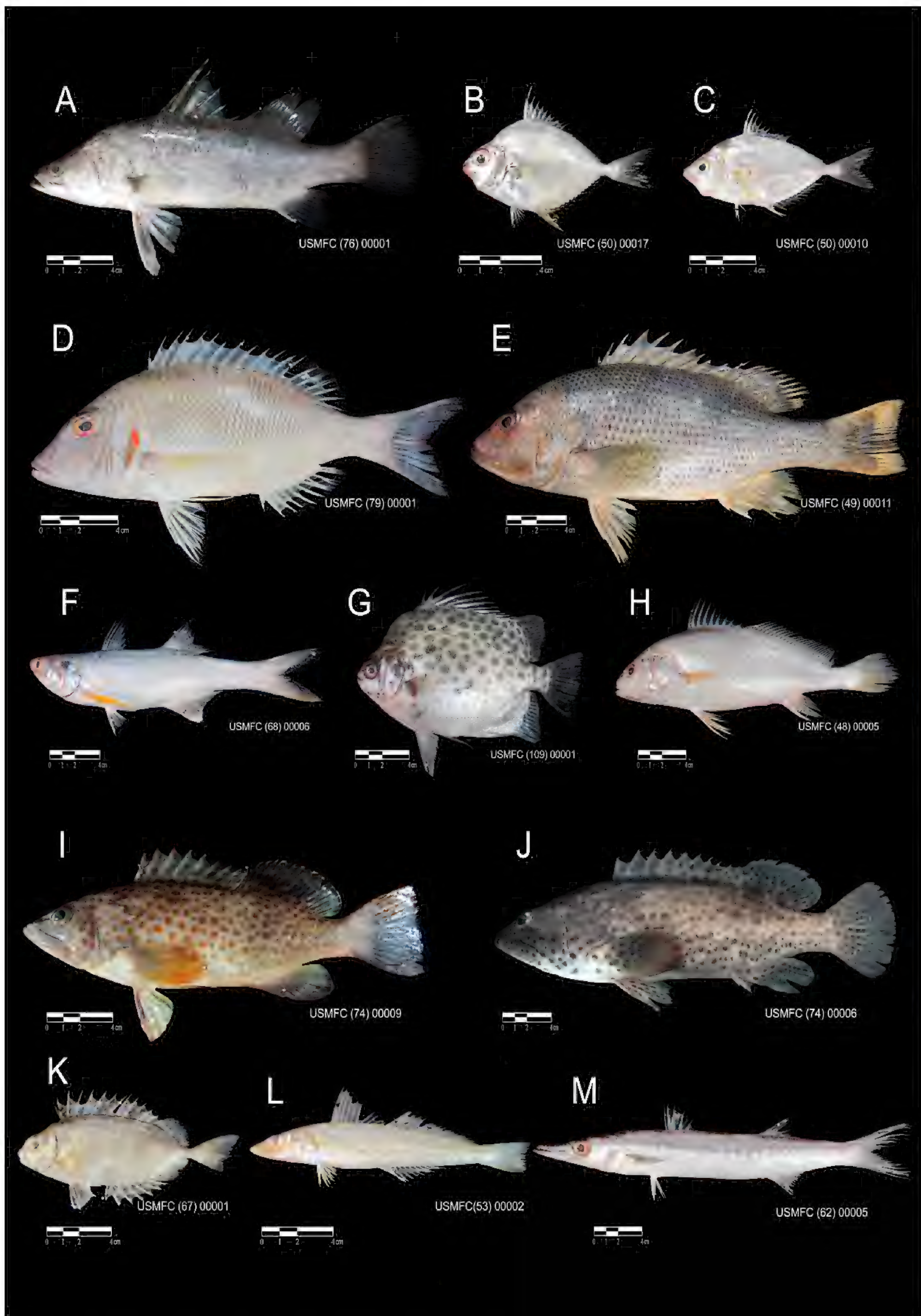
***Stolephorus baweanensis* Hardenberg, 1933**

**Material examined.** MALAYSIA • 1, 76 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00045.

**Identification.** Species recently rediagnosed by Hata et al. (2020); a small species of anchovy (maximum TL about 100 mm); body elongated and compressed; large mouth, its corner behind the eye; anal fin short with three unbranched and 17–20 branched fin rays, its origin below about middle of dorsal fin base; gill rakers 33–38 (on first gill arch); posterior tip of the maxilla just reaching posterior margin of opercle; no predorsal scute; belly not keeled; pelvic scute without spine, small needle-like prepelvic scutes 5–7; no post-pelvic scutes; body light greyish/brownish with a silver longitudinal stripe from the opercular margin to caudal-fin base; no dark pigment line on back.

*Stolephorus baweanensis* can be easily distinguished from other species of *Stolephorus* occurring in this region by “numerous black spots on suborbital area (in adults), snout and tip of lower jaw” (Hata et al. 2020:21). Previously identified as *Stolephorus waitei* Jordan & Seale, 1926 (e.g., Tongnunui et al. 2002) but *S. waitei* is endemic to the Australian region (Hata et al. 2020). *Stolephorus baweanensis* is a predominantly coastal marine species. Although commonly caught in brackish





**Figure 4.** Photographs of a selection of fish specimens (in lateral view) from the Merbok river estuary and adjacent waters. **A.** *Lates calcarifer*. **B.** *Leiognathus equula*. **C.** *Nuchequula gerreoides*. **D.** *Lethrinus lentjan*. **E.** *Lutjanus johnii*. **F.** *Eleutheronema tetradactylum*. **G.** *Scatophagus argus*. **H.** *Nibea soldado*. **I.** *Epinephelus bleekeri*. **J.** *Epinephelus coioides*. **K.** *Siganus fuscescens*. **L.** *Sillago sihama*. **M.** *Sphyræna qenie*.



ecosystems of this region, they do not seem to form large schools. Widely distributed in the northern Indo-West Pacific region (Hata et al. 2020).

***Stolephorus mercurius* Hata, Lavoué & Motomura, 2021**

**Material examined.** MALAYSIA • 1, 62 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (82) 00050.

**Identification.** Species described by Hata et al. (2021). A moderate-sized species of anchovy (maximum TL about 130 mm); body elongated and compressed; large mouth, its corner behind the eye; anal fin short with three unbranched and 16–19 branched fin rays, its origin below about middle of dorsal fin base; gill rakers 44–47 (on first gill arch); posterior tip of the maxilla just reaching posterior margin of opercle; no predorsal scute; belly not keeled; pelvic scute without spine; small, needle-like prepelvic scutes 2–5; no post-pelvic scutes; body light greyish/brownish with a silver longitudinal stripe from the opercular margin to caudal-fin base; pairs of occipital darkish patches without a following pair of dark, thin stripes (Hata et al. 2021).

*Stolephorus mercurius* can be easily distinguished from other species of *Stolephorus* occurring in the Merbok river estuary by its rounded body, no predorsal scute, no dark line on back, and no black spots on suborbital area or lower-jaw tip. *Stolephorus mercurius* is a predominantly coastal marine species occasionally caught in brackish ecosystems of this region; it is an economically important species. Otherwise, widely distributed in the West Pacific region (Hata et al. 2021).

***Stolephorus dubiosus* Wongratana, 1983**

**Material examined.** MALAYSIA • 4, 62–94 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00038. • 3, 65–69 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (82) 00049.

**Identification.** Small species of anchovy (maximum TL about 100 mm); body elongated and compressed; large mouth, its corner behind the eye; anal fin short with three unbranched and 15–19 branched fin rays, its origin below about middle of dorsal fin base; gill rakers 26–28 (on first gill arch); posterior tip of the maxilla pointed reaching or beyond posterior margin of opercle; small predorsal scute and pelvic scute with spine, belly not keeled; small needle-like prepelvic scutes 6 or 7, no post-pelvic scutes; body light greyish/brownish with a silver longitudinal stripe from the opercular margin to caudal-fin base; a pair of blackish patches behind occiput; a pair of double, black lines on back behind dorsal fin; caudal fin whitish-yellow with black margins; no black spots on suborbital area or lower-jaw tip (Whitehead et al. 1988).

*Stolephorus dubiosus* is very similar to *Stolephorus tri* (Bleeker, 1852); it can be separated only by the number of lower gill rakers (more than 24 in *S. dubiosus* vs. less than 24 in *S. tri*). Often syntopic with *Stolephorus tri* (personal observation). Distributed in Southeast Asia (Whitehead et al. 1988).

***Stolephorus indicus* (van Hasselt, 1823)**

**Material examined.** MALAYSIA • 1, 115 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00044.

**Identification.** Species rediagnosed by Hata et al. (2021). The largest species of the genus *Stolephorus* (TL up about 150 mm); body rounded and slender; large mouth, its lateral articulation behind the eye; anal fin short with three unbranched and 15–18 branched fin rays, its origin below about middle of dorsal fin base; gill rakers 36–43 (on first gill arch); posterior tip of the maxilla pointed reaching posterior margin of opercle; no predorsal scute; belly not keeled; pelvic scute without spine, small needle-like prepelvic scutes 3–5, no post-pelvic scutes; body light greyish/brownish with silvery head; a silver, longitudinal stripe from the opercular margin to caudal-fin base; a pair of black patches behind occiput; no pigment line on back; fins mostly translucent; no black spots on suborbital area or lower-jaw tip.

*Stolephorus indicus* can be easily distinguished from other species of *Stolephorus* occurring in the Merbok river estuary by its rounded body, no predorsal scute, no pigment line on back, and no black spots on suborbital area or lower-jaw tip. *Stolephorus indicus* is a predominantly coastal marine species occasionally caught in brackish ecosystems of this region; it is an economically important species. Otherwise, distributed in the coastal zones of Indian Ocean (Hata et al. 2021).

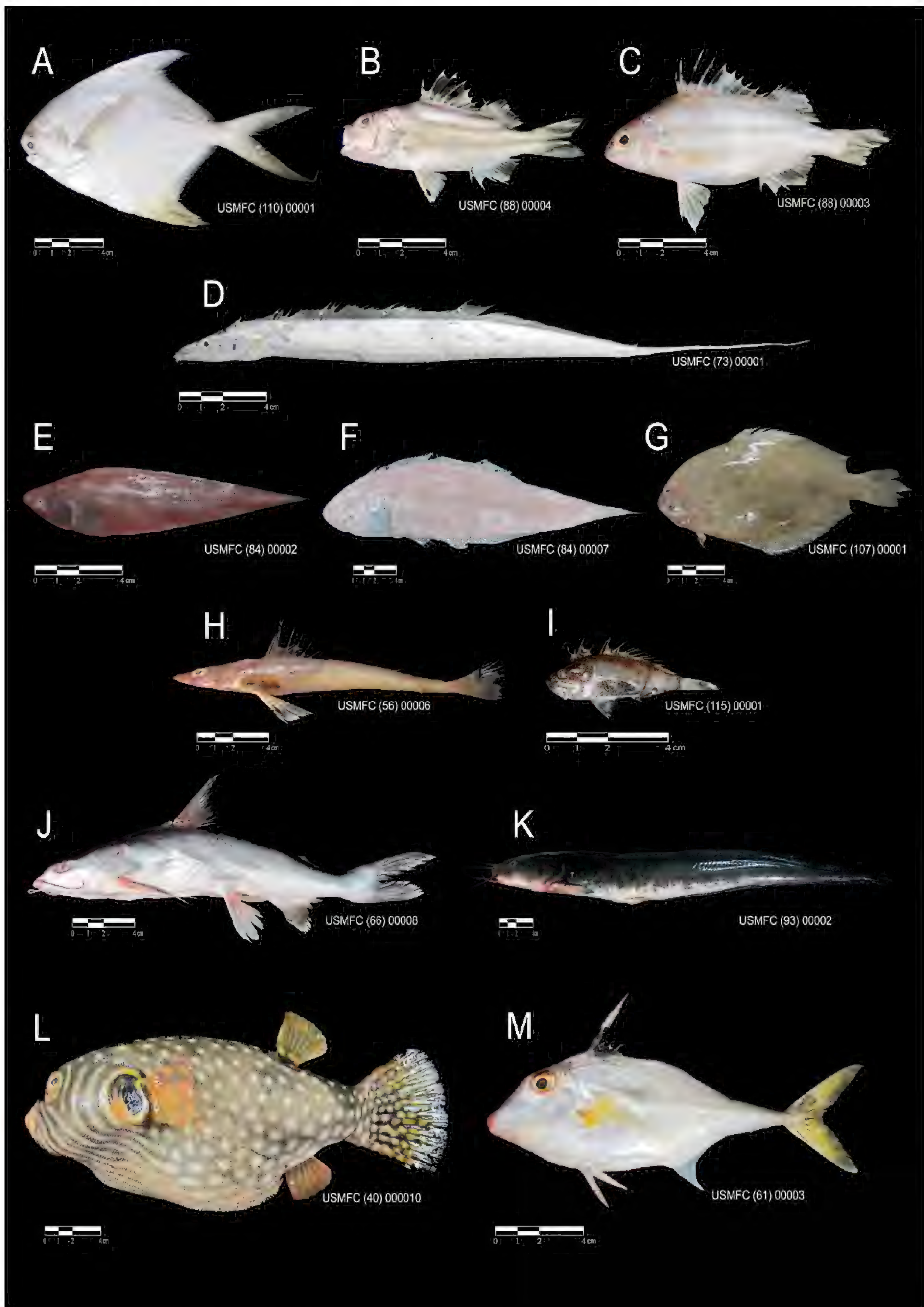
***Stolephorus tri* (Bleeker, 1852)**

Figure 3F

**Material examined.** MALAYSIA • 1, 94 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00039.

**Identification.** Species recently rediagnosed by Hata et al. (2020); a small species of anchovy (maximum TL about 100 mm); body elongated and compressed; large mouth, its corner behind the eye; anal fin short with three unbranched and 15–19 branched fin rays, its origin below about middle of dorsal fin base; gill rakers 32–39 (on first gill arch); posterior tip of the maxilla pointed reaching or beyond posterior margin of opercle; small predorsal scute and pelvic scute with spine, belly not keeled; small needle-like prepelvic scutes 4–6, no post-pelvic scutes; body light greyish/brownish with a silver stripe from the opercular margin to caudal-fin base; a pair of blackish patches behind occiput followed by a pair of black pigment lines





**Figure 5.** Photographs of a selection of fish specimens (in lateral view) from the Merbok river estuary and adjacent waters. **A.** *Pampus argenteus*. **B.** *Terapon jarbua*. **C.** *Terapon theraps*. **D.** *Lepturacanthus savala*. **E.** *Cynoglossus cynoglossus*. **F.** *Cynoglossus arel*. **G.** *Pseudorhombus elevates*. **H.** *Grammoplites scaber*. **I.** *Trichosomus trachinoides*. **J.** *Arius maculatus*. **K.** *Plotosus canius*. **L.** *Arothron reticularis*. **M.** *Triacanthus nieuhofii*.



on back; caudal fin whitish-yellow with black margins; no black spots on suborbital area or lower-jaw tip.

*Stolephorus tri* is identifiable from all other species of *Stolephorus* (except *S. dubiosus*) occurring in the Merbok estuary by the spine-like predorsal and pelvic scutes. *Stolephorus tri* can be distinguished from *S. dubiosus* by its lower number of gill rakers. A common coastal species which frequently occurs in brackish environments. *Stolephorus tri* is distributed in the central part of the Indo West Pacific region (Hata et al. 2020).

#### ***Thryssa hamiltonii* (Gray, 1835)**

**Material examined.** MALAYSIA • 2, 145–166 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00041. • 2, 97–168 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00043.

**Identification.** A relatively large species of anchovy (maximum TL about 250 mm); body elongated, compressed and keeled from isthmus to anus; large mouth, its corner behind the eye; anal fin long with 3 unbranched and 35–37 branched fin rays; less gill rakers 12–14 (on first gill arch); maxilla moderately long, reaching to edge of gill cover; prepelvic scutes 16–19; post-pelvic scutes 8–9; body silvery with a conspicuous black blotch behind upper part of gill opening; no silver longitudinal stripe; pigment lines along dorsum (Whitehead et al. 1988).

*Thryssa hamiltonii* can be easily distinguished from other species of *Thryssa* occurring in Merbok river estuary by its moderately long maxilla reaching to edge of gill cover. *Thryssa hamiltonii* is a predominantly coastal marine species occasionally caught in brackish ecosystems of this region; it is an economically important species. Otherwise, widely distributed in the Indo-West Pacific region (Whitehead et al. 1988).

#### ***Thryssa kammalensis* (Bleeker, 1849)**

**Material examined.** MALAYSIA • 5, 79–96 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00040. • 5, 87–102 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00042. • 1, 85 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00046. • 5, 86–103 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 5 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00048.

**Identification.** A small species of *Thryssa* (maximum TL about 100 mm); body elongated, compressed and

keeled from isthmus to anus; large mouth, its corner behind the eye; anal fin long with three unbranched and 30–33 branched fin rays; only 26–32 gill rakers on first gill arch; maxilla short, its posterior tip reaching just to gill opening; prepelvic scutes 15 or 16; post-pelvic scutes 8 or 9; body mostly silvery with a diagnostic blackish “saddle” on nape (Whitehead et al. 1988); no silver longitudinal stripe; no pigment line on dorsum (Whitehead et al. 1988).

*Thryssa kammalensis* can be easily distinguished from other species of *Thryssa* occurring in the Merbok river estuary by its very short maxilla reaching only to gill opening. *Thryssa kammalensis* is a coastal marine species commonly caught in brackish ecosystems of this region. Otherwise, distributed in the central part of the Indo-West Pacific region (Whitehead et al. 1988).

#### ***Thryssa mystax* (Bloch & Schneider, 1801)**

**Material examined.** MALAYSIA • 1, 120 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00051. • 1, 141 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (82) 00052.

**Identification.** A moderate-sized species of anchovy (maximum TL about 150 mm); body elongated, compressed and keeled from isthmus to anus; large mouth, its corner behind the eye; anal fin long with three unbranched and 29–37 branched fin rays; lower gill rakers 14–16 (on first gill arch); maxilla long, its posterior tip of the maxilla almost reaching to base of first pectoral fin ray; prepelvic scutes 17–19; post-pelvic scutes 8–13; body uniformly silvery with a conspicuous blackish blotch behind upper part of gill opening; no silver longitudinal stripe; no pigment line on dorsum (Whitehead et al. 1988).

*Thryssa mystax* can be easily distinguished from other species of the genus *Thryssa* occurring in the Merbok river estuary by its long maxilla reaching to base of first pectoral fin ray. *Thryssa mystax* is a predominantly coastal marine species occasionally caught in brackish ecosystems of this region; it is an economically important species. Otherwise, widely distributed in the Indo-West Pacific region (Whitehead et al. 1988).

#### **Family Pristigasteridae**

#### ***Ilisha melastoma* (Bloch & Schneider, 1801)**

Figure 3G

**Material examined.** MALAYSIA • 5, 123–136 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (92) 00004. • 1, 87 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018;



Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (92) 00006.

**Identification.** A moderate-sized species of the family Pristigasteridae (maximum TL about 150 mm); body relatively deep, strongly compressed and strongly keeled from isthmus to anus; prepelvic scutes 17–21, postpelvic scutes 8 or 9; mouth subterminal; no lateral line; eye large; only 21–25 gill rakers on first gill arch; anal fin with 35–48 fin rays; swim bladder with two tubes passing back in the muscles on either side of haemal spines (Whitehead 1985).

*Ilisha melastoma* can easily be distinguished from *Opisthopterus tardoore* (Cuvier, 1829) by the presence of pelvic fins, a longer dorsal fin, and a relatively deeper body. *Ilisha melastoma* is a predominantly coastal marine species tolerating salinity variation and commonly entering brackish ecosystems of this region (Tongnuinui et al. 2002). Otherwise, widely distributed in the Indo-West Pacific region (Whitehead 1985).

***Opisthopterus tardoore* (Cuvier, 1829)**

**Material examined.** MALAYSIA • 5, 120–139 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (92) 00005. • 5, 70–83 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 5 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (92) 00007.

**Identification.** A moderate-sized species of Pristigasteridae (maximum TL about 150 mm); body relatively elongated, strongly compressed and strongly keeled from isthmus to anus; no pelvic fin; ventral scutes 29–35; mouth subterminal, upward; no lateral line; only 22–28 gill rakers on first gill arch; anal fin with 36–51 fin rays; dorsal fin small, its insertion well behind midpoint of body; swim bladder with two tubes passing back on either side of haemal spines (Whitehead 1985).

*Opisthopterus tardoore* can easily be separated from *I. melastoma* by, among other characters, the absence of pelvic fins, a shorter dorsal fin and a relatively slender body. *Opisthopterus tardoore* is a predominantly coastal marine species tolerating wide salinity variation and commonly entering brackish ecosystems of this region (Tongnunui et al. 2002). Otherwise, widely distributed in the Indo-West Pacific region (Whitehead 1985).

Order Siluriformes

Family Ariidae

***Arius gagora* (Hamilton, 1822)**

**Material examined.** MALAYSIA • 3, 75–95 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00005.

***Arius maculatus* (Thunberg, 1792)**

Figure 5J

**Material examined.** MALAYSIA • 5, 235–260 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00008.

***Hexanematichtys sagor* (Hamilton, 1822)**

**Material examined.** MALAYSIA • 3, 275–320 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00002.

***Ketengus typus* Bleeker, 1846**

**Material examined.** MALAYSIA • 1, 128 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00006.

***Osteogeneiosus militaris* (Linnaeus, 1758)**

**Material examined.** MALAYSIA • 5, 189–250 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00009.

***Plicofollis argyropleuron* (Valenciennes, 1840)**

**Material examined.** MALAYSIA • 1, 225 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00003. • 2, 285–290 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00004.

***Plicofollis layardi* (Günther, 1866)**

**Material examined.** MALAYSIA • 1, 280 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00007.

***Plicofollis polystaphylodon* (Bleeker, 1846)**

**Material examined.** MALAYSIA • 1, 400 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (66) 00010.

Family Plotosidae

***Plotosus canius* Hamilton, 1822**

Figure 5K

**Material examined.** MALAYSIA • 1, 248 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (93) 00002.



Order Aulopiformes  
Family Synodontidae

***Saurida microptoralis* Shindo & Yamada, 1972**

Figure 2F

**Material examined.** MALAYSIA • 3, 205–254 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (51) 00003.

Order Batrachoidiformes  
Family Batrachoididae

***Allenbatrachus grunniens* (Linnaeus, 1758)**

**Material examined.** MALAYSIA • 1, 76 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.624°N, 100.395°E; 10 Oct. 2019; Sébastien Lavoué leg.; USMFC (102) 00002.

**Identification.** Maximum TL about 150 mm; body robust, slightly dorso-ventrally compressed; head broad and flattened, many short fleshy appendages around jaws; two subopercular spines; mouth large, terminal; gill openings small, restricted to sides of body; pectoral fins broad, no pore at top of pectoral-fin axil, pelvic fins anterior to pectoral fins; dorsal fin notched, first part spinous and short; second part soft and long. Body and fins brown with the presence of irregular marks consisting of few large and many small darker brown blotches.

In the Merbok region, *A. grunniens* can be distinguished from *Batrachomoeus trispinosus* (Günther, 1861) by the absence of a foramen behind the upper part of the pectoral fin insertion (Greenfield et al. 2008). *Allenbatrachus grunniens* is not often recorded in this region. A marine species widely distributed in the Indo-West Pacific region supporting lower salinity.

***Batrachomoeus trispinosus* (Günther, 1861)**

Figure 2G

**Material examined.** MALAYSIA • 1, 102 mm TL; Kedah State, Merbok, Pompang Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (102) 00001.

**Identification.** Maximum TL about 200 mm; body robust, slightly dorso-ventrally compressed; head broad and flattened, many short fleshy appendages around jaws; one strong subopercular spine; mouth large, terminal; gill openings smaller than pectoral fin base, restricted to sides of body; pectoral fins broad, distinct pore at top of pectoral fin axil, pelvic fins anterior to pectoral fins; dorsal fin notched, first part spinous and short; second part soft and long. Body brown with two or three large and irregularly shaped, dark-brown, vertical bars on each side, that do not extend on dorsal and anal fins. Fins opaque, uneven brown.

The genus *Batrachomoeus* can be distinguished from the genus *Allenbatrachus* by the presence of a foramen behind the upper part of the pectoral fin insertion

(Greenfield et al. 2008). *Batrachomoeus trispinosus* seems more common than *A. grunniens* in Merbok. A marine species widely distributed in the Indo-West Pacific region supporting lower salinity.

Order Gobiiformes  
Family Eleotridae

***Butis butis* (Hamilton, 1822)**

Figure 3J

**Material examined.** MALAYSIA • 2, 21–25 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (33) 00012. • 3, 113–125 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (33) 00003. • 2, 95–106 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (33) 00014.

***Butis humeralis* (Valenciennes, 1873)**

Figure 3K

**Material examined.** MALAYSIA • 1, 125 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (33) 00001. • 5, 87–117 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (33) 00002. • 2, 109–112 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (33) 00004.

***Butis koilomatodon* (Bleeker, 1849)**

**Material examined.** MALAYSIA • 1, 25 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (33) 00013.

Family Gobiidae

***Acentrogobius caninus* (Valenciennes, 1873)**

**Material examined.** MALAYSIA • 1, 73 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00015.

***Boleophthalmus boddarti* (Pallas, 1770)**

Figure 3L

**Material examined.** MALAYSIA • 1, 127 mm TL; Kedah State, Kampung Batu Lintang, Pompang Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00016.

***Brachygobius* cf. *kabiliensis* Inger, 1958**

**Material examined.** MALAYSIA • 3, 14–16 mm TL;



Kedah State, Semeling, Semeling Bridge; 5.680°N, 100.470°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (34) 00020.

**Identification.** A very small fish (TL ≤16 mm). Body relatively short; head large dorso-ventrally compressed; trunk and tail laterally compressed; only few large predorsal scales present; opercular scales present; anal fin rays 7; second dorsal fin rays 7 or 8; body color cream with four black bars all extending from mid-dorsal line to mid-ventral line; first bar extending to anterior part of first dorsal fin; second bar extending to anterior part of the second dorsal fin and extending to anterior part of anal fin; front head and snout black; first and second dorsal fins, anal fin and pectoral fins with black marks.

The taxonomy of the genus *Brachygobius* needs revision (Larson 2001). The combination of morphological characteristics of our specimens seems distinctive, making their identification difficult. Based on the identification key of Inger (1958), our species resembles to *B. kabiliensis* in having opercular scales, four black bars, and 7 rays at second dorsal and anal fins. However, the predorsal scale pattern and the shape of the first and second bars clearly distinguish our specimens from typical specimens of *B. kabiliensis* (as illustrated by Inger 1958: fig. 19; Huang et al 2013: fig. 1g). In *B. kabiliensis*, the first bar does not extend to the mid-ventral line, the second bar does not reach the anal fin and the predorsal region seems fully scaled (Inger 1958). We preliminary identified our specimen as *B. cf. kabiliensis*. Further taxonomic work may show that it is a distinct species.

***Exyrias puntang* (Bleeker, 1815)**

**Material examined.** MALAYSIA • 1, 152 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00018. • 1, 135 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (34) 00025.

***Favonigobius gymnauchen* (Bleeker, 1860)**

**Material examined.** MALAYSIA • 2, 100–102 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00011. • 1, 98 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00014.

***Glossogobius aureus* Akihito & Meguro, 1975**

**Material examined.** MALAYSIA • 2, 114–191 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00010. • 5, 164–239 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar.

2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00012.

***Hemigobius hoevenii* (Bleeker, 1851)**

**Material examined.** MALAYSIA • 1, 25 mm TL; Kedah State, Semeling, Semeling Bridge; 05.680°N, 100.470°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (34) 00023.

***Psammogobius biocellatus* (Valenciennes, 1873)**

**Material examined.** MALAYSIA • 1, 85 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (34) 00026.

***Pseudapocryptes elongatus* (Cuvier, 1816)**

**Material examined.** MALAYSIA • 2, 149–151 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00017.

***Pseudogobius fulvicaudus* Huang, Shao & Chen, 2014**

**Material examined.** MALAYSIA • 3, 18–23 mm TL; Kedah State, Semeling, Semeling Bridge; 05.680°N, 100.470°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (34) 00024.

***Pseudogobius olorum* (Sauvage, 1880)**

**Material examined.** MALAYSIA • 2, 27–37 mm TL; Kedah State, Semeling, Semeling Bridge; 05.680°N, 100.470°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (34) 00022.

***Stigmatogobius sadanundio* (Hamilton, 1822)**

**Material examined.** MALAYSIA • 3, 50–54 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00019. • 3, 22–30 mm TL; Kedah State, Semeling, Semeling Bridge; 05.680°N, 100.470°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (34) 00021.

***Trypauchen pelaeos* Murdy, 2006**

**Material examined.** MALAYSIA • 1, TL 160 mm; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (34) 00027.

**Identification.** Maximum TL less than 200 mm; body very elongated, moderately compressed laterally; standard length (SL) >80% of total length; head length >20% of SL; eye rudimentary; cephalic sensory canals and pores absent; pelvic fins forming a cup; body uniformly light pink.

*Trypauchen pelaeos* is very similar to *Trypauchen vagina* (Bloch & Schneider, 1801), but it can be distinguished by its less elongated body (head length >20% of SL). The type locality of this recently described species is only 40 km south of the Merbok river estuary (Murdy



2006). It is a mud-dwelling species, but more information is needed on its ecology (Murdy 2006). *Trypauchen pelaeos* may be common in estuarine environments in Southeast Asia although rarely collected because of its burrowing behaviour. *Trypauchen pelaeos* occurs in brackish and coastal muddy habitats in Southeast Asia (Murdy 2006).

***Trypauchen vagina* (Bloch & Schneider, 1801)**

Figure 3M

**Material examined.** MALAYSIA • 1, 129 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (34) 00013.

**Identification.** Maximum TL less than 200 mm; body very elongated, moderately compressed laterally; standard length (SL) <80% of total length; head length <20% of SL; eye rudimentary; cephalic sensory canals and pores absent; pelvic fins forming a cup; body uniformly light pink.

*Trypauchen vagina* can be distinguished from *T. pelaeos*, also occurring in the Merbok river estuary, by its more elongated body (head <20% of SL). A mud-dweller species but more information is needed on the ecology of *T. vagina*. It seems to be common in muddy estuarine environments in Southeast Asia but not often collected. *Trypauchen vagina* occurs in brackish and coastal muddy habitats in Southeast Asia (Murdy 2006).

Order Atheriniformes

Family Phallostethidae

***Neostethus lankesteri* Regan, 1916**

**Material examined.** MALAYSIA • 3, 27–35 mm TL; Kedah State, Semeling, Semeling Bridge; 5.680°N, 100.470°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (108) 00001.

Order Beloniformes

Family Adrianichthyidae

***Oryzias javanicus* (Bleeker, 1854)**

**Material examined.** MALAYSIA • 3, 28–35 mm TL; Kedah State, Semeling, Semeling Bridge; 05.680°N, 100.470°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (101) 00002. **Identification.** A small species of Adrianichthyidae (maximum TL <40 mm). Body deep, laterally compressed; eyes large; small mouth terminal; pectoral fins set relatively high on side of body; single dorsal fin set posteriorly; caudal fin truncate; no lateral line. Dorsal and anal fin rays of male longer and thicker than those of female.

Yusof et al. (2012) reported the presence of two species of *Oryzias* along the west coast of Peninsular Malaysia, *O. javanicus* and *Oryzias dancena* (Hamilton, 1822). According to Yusof et al. (2012), *O. javanicus* is separated by its silvery eyes and dorsal black lines whereas *O. dancena* exhibits shiny blue eyes and no black line on body.

Furthermore, *O. javanicus* is a typical brackish species, living in higher salinity habitats than *O. dancena* which is more freshwater tolerant which may explain why we did not collect it (Yusof et al. 2012). *Oryzias javanicus* is the first species (and so far, the only one) for which its whole genome has been sequenced from specimens originating from this region (i.e., Penang region) (Takehana et al. 2020).

Family Belonidae

***Strongylura strongylura* (van Hasselt, 1823)**

Figure 2H

**Material examined.** MALAYSIA • 3, 245–255 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 7.12.2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (89) 00002.

**Identification.** Maximum TL about 400 mm. Body very elongate (not eel-like) and cylindrical; elongated upper and lower jaws forming pointed snout; sharp teeth in both jaws; caudal fin rounded; dorsal-fin rays 12–15; anal-fin rays 15–18; body flanks and belly silver whitish, dorsally greenish; a distinct large (its diameter roughly equal to eye diameter) black spot on caudal fin, distal part of caudal fin yellowish.

*Strongylura strongylura* is easily recognizable in the Merbok river estuary by its elongated upper and lower jaws and the presence of a distinct large black spot on caudal fin. *Strongylura strongylura* is a common coastal species which is often encountered in brackish mangrove ecosystems. Widely distributed in the Indo-West Pacific region.

Family Hemiramphidae

***Hyporhamphus dussumieri* (Valenciennes, 1847)**

**Material examined.** MALAYSIA • 1, 235 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (105) 00002.

**Identification.** Maximum TL (from the upper jaw tip) reported about 30 cm. Body elongate and rounded in cross section, with elongated lower jaw less than 1.5 times in head length; short triangular upper jaw with pointed tip; caudal fin unevenly forked (lower lobe about 25% longer than upper lobe); gill rakers on first gill arch 36 to 47; body flanks and belly silver, back greenish/greyish; yellowish silver stripe on mid-lateral body.

Within the Merbok River estuary, the halfbeak genus, *Hyporhamphus*, is distinguishable from the viviparous halfbeak genera *Dermogenys* and *Zenarchopterus* (family Zenarchopteridae) by having the caudal fin unevenly forked (vs. rounded).

*Hyporhamphus dussumieri* can be separated from *Hyporhamphus quoyi* (Valenciennes, 1847) by its proportionally longer lower jaw (contained <5 times in SL)



and the pointed tip of its upper jaw, among other characteristics. *Hyporhamphus dussumieri* is a coastal species, sporadically frequenting estuaries. Tongnunui et al. (2002) reported two different species of *Hyporhamphus*, *Hyporhamphus affinis* (Günther, 1866) and *Hyporhamphus limbatus* (Valenciennes, 1847).

***Hyporhamphus quoyi* (Valenciennes, 1847)**

Figure 2I

**Material examined.** MALAYSIA • 3, 125–136 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (105) 00001. • 1, 151 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (105) 00005.

**Identification.** Maximum TL (from the upper jaw tip) reported about 300 mm. Body elongate and rounded in cross section, with elongated lower jaw, about twice longer than head length; short round upper jaw with rounded tip; caudal fin unevenly forked (lower lobe about 25% longer than upper lobe); gill rakers on first gill arch 26–34; body flanks and ventral part silver, dorsum greenish/greyish; yellowish silver stripe on mid-lateral body.

*Hyporhamphus quoyi* is distinguished from *H. dussumieri* by its proportionally shorter lower jaw (contained >6 times in SL) and the rounded tip of its upper jaw. *Hyporhamphus quoyi* is a common coastal species in this region regularly frequenting estuary. This species was not reported in the mangrove estuary of Sikao Creek (Tongnunui et al. 2002).

Family Zenarchopteridae

***Dermogenys sumatrana* (Bleeker, 1854)**

**Material examined.** MALAYSIA • 3, 39–56 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (105) 00004.

**Identification.** A small species of the family Zenarchopteridae. Maximum TL (from the upper jaw tip) about 60 mm (Meisner 2001). Body slender and cylindrical, with elongated lower jaw and short triangular upper jaw; upper jaw longer than wide; male with upside-down triangular spiculus of male modified anal fin (i.e., andropodium; Meisner 2001) with distal tip oriented posteriorly; body light brown with translucent fins; thick black line along dorsum from occiput to caudal fin base.

*Dermogenys sumatrana* is known from Lake Maninjau, West Sumatra (type locality), Borneo and south of Thailand (Meisner 2001; Lheknim 2004), and in the mangrove estuary of Sikao Creek (Tongnunui et al. 2002). This species is collected in the less saline part of the Merbok river estuary.

***Zenarchopterus buffonis* (Valenciennes, 1847)**

**Material examined.** MALAYSIA • 1, 143 mm TL;

Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (105) 00003.

**Identification.** Maximum TL (from the upper jaw tip) about 140 mm. Body elongated-cylindrical, with elongated lower jaw and short triangular upper jaw, wider than long; black line along the midline of the snout; black line along dorsum from occipital region to caudal fin base; 6<sup>th</sup> anal ray in adult males slightly elongate and expanded to form an andropodium (Grier and Collette 1987); caudal fin rounded; body sides and belly silver separated by a silver stripe running from gill opening to caudal fin base; caudal fin base dark greyish.

*Zenarchopterus buffonis* is a common species in this region and it had been reported by Tongnunui et al. (2002).

Order Carangiformes

Family Carangidae

***Alepes melanoptera* (Swainson, 1839)**

Figure 2L

**Material examined.** MALAYSIA • 1, 115 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00013. • 1, 188 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00014.

***Atule mate* (Cuvier, 1833)**

**Material examined.** MALAYSIA • 1, 130 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00015.

***Carangoides coeruleopinnatus* (Rüppell, 1830)**

**Material examined.** MALAYSIA • 3, 123–136 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00012.

***Caranx ignobilis* (Forsskål, 1775)**

**Material examined.** MALAYSIA • 2, 307–319 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00019. • 2, 236–251 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00020.

***Caranx sexfasciatus* Quoy & Gaimard, 1825**

**Material examined.** MALAYSIA • 1, 200 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering



Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00022.

***Megalaspis cordyla* (Linnaeus, 1758)**

**Material examined.** MALAYSIA • 5, 225–270 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00009.

***Scomberoides commersonnianus* Lacepède, 1801**

Figure 2K

**Material examined.** MALAYSIA • 1, 95 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00016.

***Scomberoides tala* (Cuvier, 1832)**

**Material examined.** MALAYSIA • 1, 188 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 7 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00018.

***Scomberoides tol* (Cuvier, 1832)**

**Material examined.** MALAYSIA • 2, 160–187 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 7 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00017.

***Selaroides leptolepis* (Cuvier, 1833)**

**Material examined.** MALAYSIA • 3, 120–128 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00010. • 5, 122–130 mm; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00010.

***Trachinotus blochii* (Lacepède, 1801)**

**Material examined.** MALAYSIA • 2, 303–311 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00021.

***Ulua mentalis* (Cuvier, 1833)**

Figure 2J

**Material examined.** MALAYSIA • 1, 191 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (69) 00011.

Family Cynoglossidae

***Cynoglossus arel* (Bloch & Schneider, 1801)**

Figure 5F

**Material examined.** MALAYSIA • 3, 264–312 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (84) 00007.

***Cynoglossus puncticeps* (Richardson, 1846)**

**Material examined.** MALAYSIA • 1, 104 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (84) 00003. • 1, 90 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (84) 00006.

***Cynoglossus cynoglossus* (Hamilton, 1822)**

Figure 5E

**Material examined.** MALAYSIA • 1, 82 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (84) 00002. • 3, 95–135 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (84) 00005.

***Cynoglossus lingua* Hamilton, 1822**

**Material examined.** MALAYSIA • 3, 225–240 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (84) 00008.

***Cynoglossus oligolepis* (Bleeker, 1855)**

**Material examined.** MALAYSIA • 1, 79 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (84) 00004.

Family Paralichthyidae

***Pseudorhombus elevatus* Ogilby, 1912**

Figure 5G

**Material examined.** MALAYSIA • 1, 186 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (107) 00001.

Family Latidae

***Lates calcarifer* (Bloch, 1790)**

Figure 4A

**Material examined.** MALAYSIA • 5, 259–300 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering



Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (76) 00001.

Family Polynemidae

***Eleutheronema tetradactylum* (Shaw, 1804)**

Figure 4F

**Material examined.** MALAYSIA • 5, 221–251 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (68) 00005. • 2, 184–202 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (68) 00006.

***Leptomelanosoma indicum* (Shaw, 1804)**

**Material examined.** MALAYSIA • 1, 264 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (68) 00004.

Order Mugiliformes

Family Mugilidae

***Crenimugil buechanani* (Bleeker, 1853)**

**Material examined.** MALAYSIA • 2, 195 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (81) 00006.

***Crenimugil crenilabis* (Forsskal, 1775)**

Figure 3N

**Material examined.** MALAYSIA • 3, 169–180 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (81) 00007.

***Osteomugil perusii* (Valenciennes, 1836)**

**Material examined.** MALAYSIA • 3, 140–145 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (81) 00003. • 1, 162 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (81) 00004.

***Planiliza subviridis* (Valenciennes, 1836)**

**Material examined.** MALAYSIA • 5, 116–135 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (81) 00001. • 2, 102–135 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari

leg.; USMFC (81) 00002. • 2, 143–150 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (81) 00005. • 3, 80–104 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (81) 00008.

Order Perciformes

Family Gerreidae

***Gerres macracanthus* Bleeker, 1854**

**Material examined.** MALAYSIA • 4, 190–196 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (91) 00008.

***Gerres filamentosus* Cuvier, 1829**

Figure 3H

**Material examined.** MALAYSIA • 3, 84–153 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (91) 00005. • 1, 140 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (91) 00006. • 5, 159–168 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (91) 00007.

***Gerres limbatus* Cuvier, 1830**

Figure 3I

**Material examined.** MALAYSIA • 4, 74–83 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (91) 00004.

***Gerres oyena* (Forsskal, 1775)**

**Material examined.** MALAYSIA • 2, 153–191 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (91) 00003.

Family Ambassidae

***Ambassis vachellii* Richardson, 1846**

**Material examined.** MALAYSIA • 3, 59–67 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (30) 00002. • 5, 59–64 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (30) 00003.



**Identification.** Small species of *Ambassis* (maximum TL about 8 cm); body elongated oval-shaped, laterally compressed; mouth terminal; interrupted lateral line; eye diameter larger than snout length; supraorbital spines 4 or 5; nasal spine present and well developed; posterior margin of preopercle serrated; single dorsal fin deeply notched; dorsal fin spines 7; anal fin spines 3; caudal fin deeply forked; body uniformly pale yellowish with scattered melanophores; fins mostly translucent, first 2 or 3 dorsal fin spines blackish.

Tentatively identified as *Ambassis vachellii* using the identification key of Allen (1999). However, the taxonomy of small species of *Ambassis* having more than one supraorbital spine needs revision. *Ambassis vachellii* can easily be distinguished from the two other species of Ambassidae occurring in Merbok river estuary by the unique combination of two characters: interrupted lateral line and 4 or 5 supraorbital spines. *Ambassis vachellii* is a typical brackish species and the most common species of Ambassidae in the Merbok river estuary and in other brackish environments in this region (e.g., Tongnunui et al. 2002). Its exact distribution in the Indo-West Pacific region is still unknown.

#### *Ambassis interrupta* Bleeker, 1853

**Material examined.** MALAYSIA • 3, 82–93 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (30) 00006.

**Identification.** Moderate-sized species of *Ambassis* (maximum TL about 10 cm); body relatively deep, laterally compressed; mouth terminal; interrupted lateral line; eye diameter larger than snout length; only 1 supraorbital spine; nasal spine absent; single dorsal fin deeply notched; dorsal fin spines 7; the third one significantly longer; anal fin spines 3; caudal fin deeply forked; body uniformly pale greyish with scattered melanophores; fins mostly translucent, first 2 or 3 dorsal fin spines blackish.

*Ambassis interrupta* can easily be distinguished from the two other species of Ambassidae occurring in the Merbok river estuary by the unique combination of two characters: interrupted lateral line and only one supraorbital spine. *Ambassis interrupta* is a typical brackish species and it occurs in other brackish environments in this region (e.g., Tongnunui et al. 2002). Its exact distribution in the Indo-West Pacific region is still unknown.

#### *Ambassis macracanthus* Bleeker, 1849

Figure 3O

**Material examined.** MALAYSIA • 2, 96–102 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (30) 00005. • 1, 71 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (30) 00004. • 2, 70–72 mm TL; Kedah

State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (30) 00007.

**Identification.** A moderate-sized species of *Ambassis* (maximum TL about 10 cm); body relatively deep, laterally compressed; mouth terminal; continuous lateral line; eye diameter larger than snout length; only 1 supraorbital spine; nasal spine absent; single dorsal fin deeply notched; dorsal fin spines 7; anal fin spines 3; caudal fin deeply forked; body uniformly pale greyish with scattered melanophores; fins mostly translucent, first 2 or 3 dorsal fin spines blackish.

*Ambassis macracanthus* can easily be distinguished from the two other species of Ambassidae occurring in the Merbok river estuary by the unique combination of two characters: continuous lateral line and only one supraorbital spine. *Ambassis macracanthus* is a brackish species and it occurs in other brackish environments in this region (e.g., Tongnunui et al. 2002). Its exact distribution in the Indo-West Pacific region is still unknown.

#### Family Haemulidae

#### *Pomadasys kaakan* (Cuvier, 1830)

Figure 3R

**Material examined.** MALAYSIA • 1, 144 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (71) 00002. • 1, 135 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (71) 00003. • 2, 265–283 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (71) 00004. • 2, 137–141 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (71) 00005.

#### Family Lethrinidae

#### *Lethrinus lentjan* (Lacepède, 1802)

Figure 4D

**Material examined.** MALAYSIA • 5, 231–259 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (79) 00001.

#### Family Lutjanidae

#### *Lutjanus argentimaculatus* (Forsskål, 1775)

**Material examined.** MALAYSIA • 1, 444 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (49) 00012.



***Lutjanus johnii* (Bloch, 1792)**

Figure 4E

**Material examined.** MALAYSIA • 1, 295 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (49) 00007. • 2, 234–334 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (49) 00011.

***Lutjanus russellii* (Bleeker, 1849)**

**Material examined.** MALAYSIA • 1, 240 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (49) 00010. • 1, 273 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (49) 00006. • 1, 270 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (49) 00008. • 4, 234–265 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (49) 00009.

Family Sciaenidae

***Dendrophysa russellii* (Cuvier, 1829)**

**Material examined.** MALAYSIA • 1, 126 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00009.

***Johnius belangerii* (Cuvier, 1830)**

**Material examined.** MALAYSIA • 2, 130–144 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00010. • 2, 106–115 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00011. • 2, 129–140 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00012.

**Identification.** A moderate-sized species of *Johnius* (maximum TL <30 cm); body elongated, laterally compressed; mouth inferior; snout blunted; no barbel on chin; anterior portion of dorsal fin with VIII or IX spines; posterior portion of dorsal fin with I spine and 25 or 26 branched rays; anal fin with seven branched rays; scale rows above lateral line to origin of dorsal fin 6; scale rows below lateral line to origin of anal fin 8; scales on upper part of body and head ctenoid; caudal fin S-shaped; body brown with pectoral and anal fins blackish.

***Johnius* sp.**

**Material examined.** MALAYSIA • 4, 105–109 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00002. • 6, 104–123 mm; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00008.

**Identification.** Body elongated, laterally compressed; mouth inferior; snout blunted; no barbel on chin; anterior portion of dorsal fin with VIII or IX spines; posterior portion of dorsal fin with I spine and 25 or 26 branched rays; anal fin with seven branched rays; scale rows above lateral line to origin of dorsal fin 6 or 7; scale rows below lateral line to origin of anal fin 9; scales on upper part of body and head ctenoid; first gill arch with about 12 gill rakers on lower limb; caudal fin pointed; body light brown with pectoral and anal fins cream.

This unidentified species can be distinguished from *J. belangerii* by its pectoral and anal fins cream (vs. blackish in *J. belangerii*) and caudal fin pointed (vs. S-shaped in *J. belangerii*). Using the identification key by Carpenter and Niem (2001a), we are unable to assign this species to any described species due to the difficulty to identify some species of the genus *Johnius*. *Johnius* sp. could be either *Johnius carouna* (Cuvier, 1830) or *Johnius coitor* (Hamilton, 1822), two species recorded around this region, or a different species, morphologically similar to them.

***Nibeia soldado* (Lacepède, 1802)**

Figure 4H

**Material examined.** MALAYSIA • 3, 237–284 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00005.

***Otolithes ruber* (Bloch & Schneider, 1801)**

**Material examined.** MALAYSIA • 5, 232–254 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00004.

***Panna microdon* (Bleeker, 1849)**

**Material examined.** MALAYSIA • 1, 210 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00007.

***Pennahia anea* (Bloch, 1793)**

**Material examined.** MALAYSIA • 3, 180–195 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00006.



***Pennahia ovata* Sasaki, 1996**

**Material examined.** MALAYSIA • 5, 188–202 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (48) 00003.

**Family Serranidae*****Cephalopholis formosa* (Shaw, 1812)**

**Material examined.** MALAYSIA • 1, 235 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 7.12.2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (74) 00008.

***Epinephelus bleekeri* (Vaillant, 1878)**

Figure 4I

**Material examined.** MALAYSIA • 2, 226–242 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 7.12.2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (74) 00009.

***Epinephelus coioides* (Hamilton, 1822)**

Figure 4J

**Material examined.** MALAYSIA • 5, 294–345 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (74) 00006.

***Epinephelus heniochus* Fowler, 1904**

**Material examined.** MALAYSIA • 1, 220 mm; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (74) 00005.

***Epinephelus sexfasciatus* (Valenciennes, 1828)**

**Material examined.** MALAYSIA • 5, 157–187 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (74) 00007.

**Family Sillaginidae*****Sillago sihama* (Forsskal, 1775)**

Figure 4L

**Material examined.** MALAYSIA • 1, 139 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (53) 00002. • 4, 143–162 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (53) 00003.

**Family Sphyraenidae*****Sphyraena barracuda* (Edwards, 1771)**

**Material examined.** MALAYSIA • 1, 156 mm TL;

Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (62) 00006.

***Sphyraena jello* Cuvier, 1829**

**Material examined.** MALAYSIA • 1, 211 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (62) 00004. • 1, 143 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (62) 00007.

***Sphyraena qenie* Klunzinger, 1870**

Figure 4M

**Material examined.** MALAYSIA • 3, 337–359 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (62) 00005.

**Family Platycephalidae*****Grammoplites scaber* (Linnaeus, 1758)**

Figure 5H

**Material examined.** MALAYSIA • 1, 125 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (56) 00006.

**Identification.** Maximum TL about 300 mm (Froese and Pauly, 2020). Body elongate, dorso-ventrally compressed, head strongly flattened with eye partially directed upward; mouth large prognathous; teeth on vomer in two distinct patches; preopercular spines three, upper spine longest; spinous and soft dorsal fins well separated; backward directed spine on each lateral line scale; body above brownish, ventrally whitish, caudal fin brownish without clear pattern.

*Grammoplites scaber* can be separated from *Platycephalus indicus* (Linnaeus, 1758) by the presence of spines on lateral line scales and the absence of pattern on the caudal fin. *Grammoplites scaber* is a common coastal species in this region which often enters brackish environments.

***Platycephalus indicus* (Linnaeus, 1758)**

**Material examined.** MALAYSIA • 1, 225 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (56) 00007.

**Identification.** Maximum TL about 1000 mm (Froese and Pauly 2020). Body elongate, dorso-ventrally compressed, head flattened with eye partially directed upward; mouth large prognathous; teeth on vomer in one slender transverse band; preopercular spines 2, lower spine longest; spinous and soft dorsal fins well separated; body brownish ventrally whitish, caudal fin with few



irregular alternate black and white stripes and a large central yellow ocellus.

*Platycephalus indicus* can be separated from *G. scaber* by the presence of only one transverse band of teeth on vomer, the absence of spines on lateral lines and the characteristic caudal marking pattern. *Platycephalus indicus* is a common coastal species in this region which often enters brackish environments (e.g., Tongnunui et al 2002).

Family Tetraogidae

***Trichosomus trachinoides* (Cuvier, 1829)**

**Material examined.** MALAYSIA • 1, 39 mm TL; Kedah State, Kampung Batu Lintang, Pampang Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (115) 00001. • 1, 40 mm TL; Kedah State, Kampung Batu Lintang, Pampang Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (115) 00002.

Order Cichliformes

Family Cichlidae

***Oreochromis mossambicus* (Peters, 1852)**

Figure 3P

**Material examined.** MALAYSIA • 1, 103 mm TL; Kedah State, Kampung Batu Lintang, Pampang Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (47) 00005.

Order Acanthuriformes

Family Drepaneidae

***Drepane longimana* (Bloch & Schneider, 1801)**

**Material examined.** MALAYSIA • 1, 99 mm TL; Kedah State, Merbok, Pampang Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (60) 00002.

***Drepane punctata* (Linnaeus, 1758)**

Figure 3Q

**Material examined.** MALAYSIA • 3, 234–278 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (60) 00003.

Family Leiognathidae

***Deveximentum ruconius* (Hamilton, 1822)**

**Material examined.** MALAYSIA • 2, 58–70 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00013.

***Deveximentum indicium* (Monkolprasit, 1973)**

**Material examined.** MALAYSIA • 1, 80 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal

Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00012. • 1, 63 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00015.

***Deveximentum hanedai* (Mochizuki & Hayashi, 1989)**

**Material examined.** MALAYSIA • 1, 84 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00014.

***Eubleekeria jonesi* (James, 1971)**

**Material examined.** MALAYSIA • 1, 86 mm TL; Kedah State, Merbok, Pampang Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00016.

***Leiognathus brevirostris* (Valenciennes, 1835)**

**Material examined.** MALAYSIA • 3, 87–90 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00011.

***Leiognathus equula* (Forsskal, 1775)**

Figure 4B

**Material examined.** MALAYSIA • 3, 90–97 mm TL; Kedah State, Kampung Batu Lintang, Pampang Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00017.

***Nuchequula gerreoides* (Bleeker, 1851)**

Figure 4C

**Material examined.** MALAYSIA • 5, 101–114 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00010. • 5, 65–76 mm; Kedah State, Kampung Batu Lintang, Pampang Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (50) 00018.

Family Scatophagidae

***Scatophagus argus* (Linnaeus, 1766)**

Figure 4G

**Material examined.** MALAYSIA • 5, 129–151 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 4 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (109) 00001.

Family Siganidae

***Siganus fuscescens* (Houttuyn, 1782)**

Figure 4K

**Material examined.** MALAYSIA • 1, 139 mm TL; Kedah State, Merbok, Pampang Sungai Merbok; 05.664°N,



100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (67) 00001.

***Siganus javus* (Linnaeus, 1766)**

**Material examined.** MALAYSIA • 5, 118–134 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (67) 00002.

Order Scombriformes  
Family Stromateidae

***Pampus argenteus* (Euphrasen, 1788)**

Figure 5A

**Material examined.** MALAYSIA • 1, 155 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (110) 00001. • 5, 162–174 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (110) 00002.

Family Trichiuridae

***Lepturacanthus savala* (Cuvier, 1829)**

Figure 5D

**Material examined.** MALAYSIA • 3, 301–361 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (73) 00001.

Order Centrarchiformes  
Family Terapontidae

***Terapon jarbua* (Forsskål, 1775)**

Figure 5B

**Material examined.** MALAYSIA • 1, 94 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (88) 00004. • 1, 19 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.625°N, 100.394°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (88) 00006.

***Terapon theraps* Cuvier, 1829**

Figure 5C

**Material examined.** MALAYSIA • 1, 42 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (88) 00003. • 1, 131 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (88) 00005.

Order Tetraodontiformes  
Family Tetraodontidae

***Arothron reticularis* (Bloch & Schneider, 1801)**

Figure 5L

**Material examined.** MALAYSIA • 1, 266 mm TL; Kedah State, Kampung Batu Lintang, Pompong Batu Lintang; 05.624°N, 100.395°E; 19 Apr. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (40) 000010.

***Dichotomysctere cf. fluviatilis* (Hamilton, 1822)**

**Material examined.** MALAYSIA • 1, 164 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (40) 00006.

**Identification.** Maximum TL less than 200 mm (Dekkers 1975). Body stout, dorsal and ventral profiles convex; marking pattern irregular, complex; dorsum with two black blotches between head and dorsal fin: first large asymmetric blotch between pectoral fins, second oval blotch in front of dorsal fin; side with small plain black spots and few large black circles with few large black ring spots: one below the base of dorsal fin, one at base of caudal fin and one below the second dorsal blotch; ventrolateral surface greyish; pectoral, dorsal and anal fins mostly plain greyish; caudal fin greyish with fainted crossbars.

This specimen share marking pattern similarities with *Dichotomysctere fluviatilis* (Hamilton, 1822), which naturally occurs along the coasts of India, Bangladesh and Myanmar, in having two dorsal, black blotches between head and dorsal fin and the presence of distinct spots nearby the base of dorsal fin, at the base of caudal fin and below the second dorsal blotch (Dekkers 1975). Our specimen also presents difference such as the absence of a third transverse black blotch on the posterior part of the head. More specimens are needed to confidently resolve the taxonomic status of this species.

***Dichotomysctere nigroviridis* (Marion de Procé, 1822)**

**Material examined.** MALAYSIA • 2, 45–102 mm TL; Kedah State, Semeling, Semeling Bridge; 5.680°N, 100.470°E; 17 Jul. 2019; Sébastien Lavoué leg.; USMFC (40) 00011.

**Identification.** Maximum TL less than 200 mm (Dekkers 1975). Body stout, dorsal and ventral profiles convex. Dorsum and upper sides greenish gold with irregular rounded spots of diameter equal to or smaller than eye's diameter, evenly scattered; ventrolateral surface light whitish; pectoral fins translucent, dorsal and anal fins plain; caudal fin with fainted crossbars (larger specimen).

*Dichotomysctere nigroviridis* (until recently known as *Tetraodon nigroviridis*; see Igarashi et al. 2013 and Kottelat 2013 for current phylogenetic and nomenclatural information) is an important research model in genetics because of the small size and compact nature of its genome, leading to its complete sequencing early in the



21th century (Jaillon et al. 2004). This species is known from this region since the work of Cantor (1849), who described *Tetrodon simulans* Cantor, 1849 which is currently considered as a junior synonym of *D. nigroviridis*.

***Lagocephalus lunaris* (Bloch & Schneider, 1801)**

**Material examined.** MALAYSIA • 1, 67 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (40) 00005. • 2, 72–102 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (40) 00004. • 1, 154 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (40) 00007. • 3, 120–142 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (40) 00008.

***Takifugu oblongus* (Bloch, 1786)**

**Material examined.** MALAYSIA • 1, 102 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (40) 00009.

Family Triacanthidae

***Triacanthus nieuhofii* Bleeker, 1852**

Figure 5M

**Material examined.** MALAYSIA • 1, 136 mm TL; Kedah State, Merbok, Pompong Sungai Merbok; 05.664°N, 100.381°E; 6 Dec. 2018; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (61) 00002. • 1, 145 mm TL; Kedah State, Kuala Kedah, Kuala Muda Whispering Market; 05.578°N, 100.341°E; 19 Mar. 2019; Danial H. Zainal Abidin, Norli F.M.A.H. Alshari leg.; USMFC (61) 00003.

## Discussion

We documented the presence of 138 species of fish in the Merbok river estuary and adjacent marine areas. All specimens were curated and deposited in the ichthyological collections of the Makmal Rujukan Zoologi (Zoological Reference Laboratory) of Universiti Sains Malaysia where they are available for future comparative research work.

We were unable to unquestionably assign one species of sciaenid (about 0.7% of the total number of species) to known species because of the difficulty to examine and interpret some morphological characters. Further taxonomic studies are needed to clarify the status of this species, which should ideally be based on combined morphological and molecular approaches.

Although we found only a small (<14%) overlap between the 76 species directly collected in the Merbok

river estuary and the 82 species from adjacent marine areas, most of these species (regardless of their collection localities) are known to be tolerant of variation in salinity and to enter brackish environment (Carpenter and Niem 1999a, 1999b, 2001a, 2001b).

The fish fauna of the Merbok river estuary is still poorly studied and known. Mansor et al. (2012a, 2012b) indicated the presence of up to 81 species of fish (from 35 families) in the Merbok river estuary, only 68 species are enumerated in the Appendix I to Mansor et al. (2012a), and there is no record of repository for their collection). We collected 76 species of fish from the estuary itself. After updating the nomenclature, the taxonomic comparison shows a mere 25% overlap between our list and that of Mansor et al. (2012a). This could be the result of either misidentifications and/or incomplete sampling. For example, we note that Mansor et al. (2012a) reported the presence of *Megalops cyprinoides* (Broussonet, 1782) (Megalopidae) and *Elops hawaiiensis* Regan, 1909 (Elopidae), two species easily identifiable, indicating that we failed to document these two species. This may be the consequence of our limited methods of collection, which selectively targeted small species that occur in the shallowest parts of the estuary. On the other hand, we collected the shark *Chiloscyllium indicum* (Hemiscylliidae) and three species of Ambassidae that Mansor et al. (2012a) did not collect. In term of species per family, we collected significantly more species than Mansor et al. (2012a) for Engraulidae (seven vs. only two species) and Gobiidae (14 vs. only three species). On the other hand, Mansor et al. (2012a) collected six species of Mugilidae, whereas we were able to collect only one species within the estuary, but four others from the adjacent marine environment. Finally, we note that Mansor et al.'s (2012a) list is mainly composed of species targeted by the local fishermen, whereas we included in our list several small species without commercial value (e.g., several species of gobiids and *Neostethus lankesteri*).

An intensive study by Tongnunui et al. (2002) on the fish community of the Sikao Creek mangrove estuary, Trang Province, Thailand, collected more than 25,000 specimens using three fishing methods at six sampling sites. This estuary is only 100 km north of Merbok river estuary. These authors listed 135 species in 43 families (no specimen seems to have been preserved in a museum collection). The taxonomic comparison reveals only a 25.7% species similarity with our list. In particular, we did not collect any specimens from 10 of the 43 families listed by Tongnunui et al. (2002): Elopidae, Bagridae, Atherinidae, Apogonidae, Toxotidae, Blenniidae, Callionymidae, Scombridae, Mullidae, and Monacanthidae. These are indirect lines of evidence that our current list is still far from complete, evidently by insufficient fishing methods. On the other hand, despite their large sampling effort, Tongnunui et al. (2002) only found one species of Cynoglossidae (vs. five in our study), two species of Sciaenidae (vs. eight in our study) and no Ophichthyidae (vs. one in our study). Several species of these three families



frequent brackish environments (Carpenter and Niem 1999a, 2001a, 2001b). The differences between studies may reflect a real difference in species diversity between the Merbok river estuary and the Sikao Creek mangrove estuary due to pollution, overfishing, or different ecological conditions. It may also reflect the incompleteness of both lists.

Overall, the taxonomic differences between our study and previous studies in this region strongly suggest that the list of species from the Merbok river estuary is still far from comprehensive. There are several actions needed to reach completeness: 1) increase sampling effort and diversify methods of fishing, 2) improve taxonomic knowledge, and 3) establish catalogued specimens in a recognized museum. More sampling effort will unambiguously reveal additional species, especially for small, secretive, and cryptic taxa such as gobiids, blenniids, or callionymids. Although we used the most recent reference to identify our specimens, the taxonomy of several taxa is still insufficiently studied, which has led to preliminary identifications. In recent years, the taxonomy of several families has been well examined (e.g., Leiognathidae, Polynemidae, Sphyrnidae, and Gerreidae), but the taxonomy of several other families, including Cynoglossidae, Mugilidae, and the very diverse Gobiidae, are particularly in need of further research. To complement traditional morphological examination, reliable molecular identification is very much needed. Finally, we think that local museum collections comprising both specimen vouchers and tissue samples must be developed and coordinated among institutions in order to facilitate access to reference material for the local research communities in biodiversity.

Although only five species were identified as Near Threatened according to the IUCN Red List (IUCN 2020), the biodiversity of the Merbok river estuary is currently under multiple threats, including overfishing, intensive aquaculture, and industrial activities and pollution, despite its protected status (Lim et al. 1995; Shazili et al. 2006; Ateshan et al. 2020). Any future sustainable management within the estuary aiming to preserve the functioning of this complex ecosystem requires biodiversity consideration. We provide a preliminary checklist of the fish species occurring in Merbok river estuary and adjacent waters, which demonstrates the exceptional diversity of this area and provides essential information for conservation and future study.

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## Authors' Contributions

DHZA, SL, and NFMAHA collected and processed the samples. DHZA, NAMA, and SL analysed and prepared the manuscript. All of the other authors contributed in finalising the manuscript.

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